Exploring Contexts and Experiences of Sport, Physical Activity, and Sedentary Behaviour Among Asian Indian Migrants in Australia

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ABSTRACT

The Indian migrant population is at a high risk of non-communicable diseases perpetuated by low levels of physical activity both in their country of origin and in host countries. The literature lacks a comprehensive exploration of how migration impacts physical activity among Indian migrants and this gap highlights the need for context-based measures that consider pre- and post-migration factors in addressing the continued low physical activity levels observed in migrant populations.

This thesis explores, measures, and describes the key contextual factors influencing physical activity and sedentary behaviour among Indian migrants living in Australia. The uniqueness of the study lies in its focused examination of the Asian Indian migrant population in Australia, including a pre-to-post-migration comparison of various contextual factors to gain deeper insights into how migration affects lifestyle health behaviours, particularly participation in physical activity and sport.

Adopting a pragmatic approach, the research aims to generate actionable insights to inform policy and research practice-oriented implications in promoting physical activity among Indian migrants in Australia. The study consists of an exploratory sequential design and a parallel policy study within a multistage mixed-methods framework, encompassing qualitative interviews, survey adaptation and administration, and documentary analysis.

The qualitative study reveals how migration and cultural background shape the perception and practice of physical activity. Participants define physical activity holistically, emphasising the mind–body connection alongside social, cultural, and environmental factors. Sedentary behaviour is broadly defined as “not having movement” or “being lazy,” linking these behaviours to purpose and duration. Comparing their experiences as migrants in Australia with their pre-migration experiences in India, key qualitative insights suggest that sociocultural contexts are vital in influencing migrant participation in physical activity. A perceived lack of social connection emerged as a major barrier in both neighbourhoods and wider communities. The physical environment in Australia (e.g., availability of facilities and built environment) support physical activity, while work characteristics (e.g., the nature of job) encourage sedentary behaviour. These findings informed the adaptation of a pre-to-post-migration survey design measuring overall physical activity levels and social influences such as neighbourhood social capital and health communication. Migration is associated with changes in physical activity levels. Age, change in

fusion identity, and change in social support explained 22.5% of the variance in change in physical activity levels pre-to post-migration. The associations found with specific factors, namely change in social support, change in neighbourhood attachment, and change in social cohesion, suggest that when each of these factors changed, it was predictive of how much an individual's physical activity level could increase or decrease. Each factor explained a portion of the variation in physical activity level changes: 12.6% for social support, 12% for neighbourhood attachment, and 11.6% for social cohesion. Policy insights indicate few direct initiatives are proposed to promote migrant participation and inclusion in sport, suggesting deliberate efforts are needed to explicitly target migrants and encourage cross-sector collaborations between immigration, sport, and health sectors. The importance of the Victorian state government considering migrant-friendly sports and physical activity policies is emphasised in serving the interest of the rapid and rising Indian community.

This study has both theoretical and practical implications. Theoretically, it deepens understanding of the relationship between changes in sociocultural factors and changes in physical activity levels. Practically, it provides recommendations for policies and research practices to promote the integration and inclusion of migrants through sport and physical activity. These include *addressing* pre-to-post-migration changes in sport and physical activity patterns, *adapting* physical environments to promote access to opportunities, *promoting* social cohesion and bridging gaps using mainstream sport for inclusion*, adopting* holistic health approaches, *promoting* integrated workplace strategies, and *implementing* strategies for new arrivals.

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ATTESTATION OF AUTHORSHIP

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor used artificial intelligence tools or generative artificial intelligence tools (unless it is clearly stated, and referenced, along with the purpose of use), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.



Siona Fernandes

Date: 28th April 2025

CO-AUTHORED WORKS

CHAPTER 4: Fernandes, S., Caperchione, C., Thornton, L., & Timperio, A. (2021). A qualitative exploration of perspectives of physical activity and sedentary behaviour among Asian Indian migrants in Melbourne, Australia: How are they defined and what can we learn? *Published manuscript*

CHAPTER 5: Fernandes, S., Hinckson, E., & Richards, J. (2023). Qualitative insights on the importance of sociocultural contexts on Asian Indian migrant participation in physical activity and sedentary behaviour. *Published manuscript*

CHAPTER 6: Fernandes., S., & Hinckson, E. (2024). Adapting surveys for Asian Indian Migrants: Exploring experiences of physical activity and sport in the pre- to post-migration context. *Draft manuscript.*

CHAPTER 7: Fernandes, S., & Stewart, T. (2024). Sociocultural correlates of physical activity and sport among Asian Indians in Australia: A pre-to-post migration observational study. *Draft manuscript.*

CHAPTER 8: Fernandes, S., & Holroyd, E. (2025). Fostering equity in and through sport: A content analysis of physical activity and sport policies for migrants in Australia. *Draft manuscript.*

We, the undersigned, hereby agree with the percentages of contribution to the chapters identified above and agree to the inclusion of the joint work in this thesis:

Professor Eleanor Holroyd

Associate Professor Tom Stewart

Note. The signed co-authorship protocol is provided in Appendix A.

DEDICATION

To individuals whose unconditional and unwavering support has stood the test of time.

Their memories and the qualities they embody have been a guiding force through this journey and in life.

Guru and Professor Krishnamurthy

Guru and Professor Krishnamurthy, your lasting influence and wisdom remain an eternal companion, leading me, quietly and firmly, through the storms or stillness life may offer.

In loving memory of Chris Martin and Lee whose unexpected departures during my PhD were deeply felt.

With deepest gratitude.

ETHICS APPROVAL

DEAKIN UNIVERSITY

Deakin University Human Ethics Advisory Group-Health HEAG – H,
Ethics Application Number HEAG-H 93_2019, Deakin University, Faculty of Health, Melbourne, Australia.
Ethics approval for the Qualitative Study Phase I, inclusive of the participant information sheets and consent form (Appendix B)

AUCKLAND UNIVERSITY OF TECHNOLOGY

Auckland University of Technology Ethics Committee (AUTEC),
Ethics Application Number 22/223, Faculty of Health and Environmental Sciences, Auckland University of Technology, Auckland, New Zealand.
Ethics approval for the Quantitative Study Phase II, inclusive of the participant information sheets and consent form (Appendix C).

ABBREVIATIONS

CALD	Culturally and Linguistically Diverse
GPAQ	Global Physical Activity Questionnaire
ICC	Intraclass Correlation Coefficient
IMS-PAQ	Indian Migration Study PAQ
IPAQ	International Physical Activity Questionnaire
LG	Local Government
MET	Metabolic Equivalent of Task
MPAQ	Madras Physical Activity Questionnaire
NCD	Non-Communicable Disease
PA	Physical Activity (used in tables and illustrations)
PAQ	Physical Activity Questionnaire
SB	Sedentary Behaviour (used in tables and illustrations)
US	The United States
UK	The United Kingdom

DEFINITIONS

South Asian: Descendants from South Asian countries such as India, Maldives, Pakistan, Bhutan, Sri Lanka, Nepal, and Bangladesh (Shrivastava & Misra, 2015).

Indian: Those individuals with India as their birth country (Sinnapah et al., 2009).

Indian migrants: Indian-born individuals currently living in a host country.

Acculturation: The socialisation process in which change may be the consequence of direct cultural transmission; either from non-cultural causes, e.g., ecological, demographic modification induced by new culture; or delayed, as with internal adjustments upon the acceptance of alien traits or patterns; or a reactive adaptation of traditional modes of life (Barnett, 1954).

Ethnic minorities: A concept used for heterogeneous groups that share a minority status in their country of residence due to ethnicity, place of birth, language, religion, citizenship and cultural differences (Langøien et al., 2017, p. 2).

Physical activity: Any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen et al., 1985, p. 126).

Inactivity: 'Inactivity' describes not fulfilling daily physical activity recommendations due to inadequate levels of moderate-to-vigorous physical activity (Tremblay et al., 2017). Accordingly, being classified as inactive may not necessarily mean that one's behaviour is highly sedentary; and, in reverse, someone with high levels of sedentary behaviour may not necessarily mean that one is inactive either (van der Ploeg & Hillsdon, 2017).

Exercise: Any planned, structured and repetitive bodily movement performed to maintain or improve one or more components of fitness physical activity (Caspersen et al., 1985, p. 126; Howley, 2001).

Sedentary behaviour: Any waking behaviour that expends energy that is lower than or equal to 1.5 metabolic equivalents (METs – a term for exercise intensity) and encompasses only activities performed in a lying, sitting, or sleeping posture. For example, driving, reading, watching TV,

computer-related behaviour, being in a reclining position, or sitting (Lewis et al., 2017; Tremblay et al., 2017). An activity may be considered sedentary when the behaviour performed has no requirement for expending energy (Bames et al., 2012).

Health behaviours: Behaviours that have a significant impact on an individual's health such as physical activity, smoking, diet and alcohol intake (Jonnalagadda & Diwan, 2005).

First-generation migrants: Those with native country of birth who migrated to the host country at the age of 12 or older (Smith et al., 2012).

Second-generation migrants: Those born in their current country of residence or those who had immigrated to their current country of residence before 12 years of age. (Note: The age 12 cut-off is used because it correlates with subsequent exposure to a significant period of childhood and secondary schooling which are considered important influences for both changes in behaviour and social mobility) (Smith et al., 2012, p. 509).

Equity: Refers to actions and services that deliver outcomes for culturally and linguistically diverse (CALD) Australians on par with those for other Australians (Australian Government, 2018). This thesis adopts this definition for migrants who are often grouped under the heading 'CALD'.

Metabolic equivalent: The metabolic equivalent of a task is a unit used in clinical literature. It refers to the multiple of the oxygen consumed during the specified activity to a standard oxygen consumption at rest (Vaz & Bharathi, 2004, p. 541).

CHAPTER 1. INTRODUCTION

1.1. Background

Migration

Recently, the pressure of globalisation has provoked research interest in 'migration' as a public health issue (Wild & Dawson, 2018). International migration is growing, with projections estimating there will be 405 million migrants by 2050, forming a transnational community regarded as a distinct 'nation' (Hossin, 2020). In particular, international migration has led to a large proportion of migrants moving from low- and middle-income countries to high-income societies, such as the United Kingdom, the United States, Canada, New Zealand, and Australia (Bauman et al., 2009). However, migrants are a diverse community and should not be isolated in any social and relational context, especially when addressing their health needs. This is particularly the case for migrants from South Asian communities.

The South Asian population and the global burden of disease

South Asian communities, namely India, Maldives, Pakistan, Bhutan, Sri Lanka, Nepal, and Bangladesh, make up one-fifth of the world's population and disproportionately contribute to 52% of the global mortality related to non-communicable diseases (NCDs) (Shrivastava & Misra, 2015). The NCD burden mainly stems from type 2 diabetes, cardiovascular disease, respiratory disease, and cancer (Siegel et al., 2014), a specific group of diseases responsible for 82% of all deaths caused by NCDs, with an estimated 16 million NCD deaths to occur before the age of 70 (Bennett et al., 2018; Hadian et al., 2021). The expected annual rise in deaths from NCDs, estimated at 52 million by 2030, engenders a 'global' public health challenge (Hadian et al., 2021).

For India, 63% of deaths attributed to NCDs are primarily due to cardiovascular diseases and type 2 diabetes (World Health Organization, 2018b). Such health risks are not only a public health issue for the Indian population in India but also as migrants in their host country (Ardeshna et al., 2017; Gidwani et al., 2021; Hastings et al., 2015). This stems from the unique genetic makeup (Vimaleswaran et al., 2016) predisposing the Indian population to an early onset of NCDs (Arokiasamy, 2018; Gupta & Brister, 2006; Jayashree et al., 2015; Kalra et al., 2023). Kalra et al. (2023) discussed how a combination of early life biological factors, population-level transitions (epidemiological, demographic, nutritional, environmental, social-cultural, and economic), and inherent genetic and metabolic differences, may result in a higher susceptibility of Indians to

cardiovascular diseases at lower risk thresholds compared to other populations (Kalra et al., 2023). For the Indian diaspora, the adaptation process (acculturation) may compound their genetic predispositions, escalating their NCD burden and, over time, this can become a public health challenge (Abate & Chandalia, 2001). Such health-related risks are perpetuated by their low physical activity levels and engagement in sedentary behaviour when compared to the wider population, in their country of origin, and as migrants (Meeks et al., 2016; Nag & Ghosh, 2013; Yusuf et al., 2004). Understanding their physical activity and sedentary behaviours is critical in addressing preventable health risks, i.e., type 2 diabetes, and cardiovascular diseases. However, challenges arise when Indians are positioned together with other South Asian migrants. Such broad categorisation, while seemingly practical, may obscure the differences across each South Asian region. For instance, physical activity patterns and health outcomes can vary widely not only between South Asian countries but also within them. Further complexity emerges when other Asian groups beyond South Asia are included. Noticeable variations can exist when data are broken down into different Asian groups. While cancer was the leading cause of death in most Asian groups, this was not the case for Asian Indians. Among Asian Indians, heart disease was the leading cause of death, accounting for 31% of deaths, nearly double the proportion attributed to cancer (18%) (Hastings et al., 2015). Similar variations in the prevalence of physical inactivity exist within and across South Asian countries. For instance, a report using the WHO STEPwise Approach to data Surveillance (WHO STEPS), a standardised method to data surveillance on key NCD risk factors in countries which utilises the GPAQ, showed the prevalence of physical activity among adults in India ranged from 18.5% to 88.4%, Pakistan reported a prevalence of 60%, and Sri Lanka ranged from 11–31.8% (Ranasinghe et al., 2013). These variations underscore the importance of disaggregating data, limiting broad generalisations, and tailoring public health interventions more effectively.

Generalising culturally and linguistically diverse communities in physical activity research

The term ‘culturally and linguistically diverse’ (CALD) is mainly used in Australia to reflect the diverse communities that make up the population in the country. CALD communities are identified based on key indicators, including country of birth, language spoken at home (other than English), English proficiency, and Indigenous status. Additional factors, such as cultural background, ethnicity, and migrant or refugee status, may also be considered, with migration status often determined by an individual's movement to Australia or visa type (Pham et al., 2021). While migrants are part of CALD communities, indicators specifically relevant to migrants, such as ethnicity or length of residence in Australia, are less commonly used. By relying on basic indicators, the term groups migrants with a broad range of other communities, which have

different needs and experiences. This limits the effectiveness of research and policies designed to address the specific needs of migrant populations when broadly focusing on CALD communities.

The aforementioned South Asian countries not only possess a distinct perception of their national identity, kinship or social belonging, and cultural preferences (Lucas et al., 2013), but also have varying levels of physical activity (Ranasinghe et al., 2013). Concerns have been raised about how interpretations are made from findings when categorically clustering these culturally distinct communities as South Asians, Asian, Southeast Asian, or other Asians in physical activity and other health-related research (Dokuru et al., 2024; McLennan & Jayaweera, 2014; O'Driscoll et al., 2014). Such a homogenous, one-size-fits-all research approach has failed to understand the cultural distinctiveness of each migrant population group with their respective physical activity and sedentary behaviour (Lucas et al., 2013; O'Driscoll et al., 2014). Not accounting for their inherent heterogeneity in physical activity research also challenges the transferability of the findings to practice (Lucas et al., 2013). Understanding the distinct preferences and behaviours of migrants, such as their preferred types of physical activity and what is the optimal amount of exercise, may provide valuable insight to help inform and tailor policies better suited to improving health outcomes for at-risk groups, such as the Indian community.

Physical activity – how much is enough?

Physical activity is any bodily movement that expends energy (World Health Organization, 2020). In daily life, engaging in physical activity may stem from various domains, namely: the work-related (occupational) domain; household tasks; active travel, e.g., walking or cycling; and leisure-related physical activity. The leisure domain includes a variety of activities, such as sports, exercise conditioning or yard work. There is a growing importance of sport in promoting physical activity and addressing health disparities among migrant populations (Milton et al., 2021). Through the leisure domain of physical activity, sport may often be preferred because it is performed at the discretion of individuals, accommodating personal needs, interests, and schedules. For instance, as a way of engaging in physical activity, individuals may participate in sports during their free time, for enjoyment, fitness, social connection or competition.

For optimal health gains, the World Health Organization has recommended individuals perform at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity weekly (Bull et al., 2020; World Health Organization, 2020). These guidelines are not explicit in stating the domain or type of physical activity. Many countries have similar country-specific

guidelines, including Australia (Australian Department of Health and Aged Care, 2021), the United States (Pate et al., 1995), and Canada (Tremblay et al., 2011).

Specific guidelines for the nation of India were developed in 2012, due to the paucity of recommendations addressing the population's high risk of NCD, and international recommendations were not considered appropriate when derived predominantly from European studies (Misra et al., 2012). In India, physical activity guidelines recommended a higher volume than World Health Organization recommendations and those from other specific countries, given the population's increased susceptibility to health risks, e.g., incidence of cardiovascular disease and type 2 diabetes. At an individual level, Indian-specific guidelines recognised low physical activity as activities with a slight increase in heart rate, when performing house-related chores such as tidying, cleaning, and cooking. Moderate-intensity activities, such as water aerobics, cycling for fun at easy pace, gardening, and house cleaning, were described as an observable increase in breathing yet easy enough for conversation. Vigorous activity during leisure sports such as jogging, skipping, and dancing, obstructed the flow of conversation in needing to pause for breath (Misra et al., 2012). Table 1, below, summarises the Indian physical activity recommendations along with those from the World Health Organization and Australia.

Sedentary behaviour – how much to avoid?

The World Health Organization (2020) has advised adults to spend less time on sedentary behaviours and instead engage in at least some light physical activity. The Indian-specific guidelines encourage Indian adults to avoid any inactive behaviour (Misra et al., 2012). In contrast, Australia's recommendations suggest interrupting prolonged sitting behaviour with frequent breaks (Australian Department of Health, 2017).

Table 1 *Indian, Australian, and International Recommendations for Physical Activity among Adults*

Indian Recommendations	Australian Recommendations	World Health Organization Recommendations
Be physically active as much as possible; Limit inactivity at all costs.	Engage in some form of daily activity.	
Daily: a total of 60 mins (aerobic). Daily 30 mins moderate aerobic + 15 mins work-based + 15 mins muscle strength.	Weekly: 150 to 300 mins (2½ to 5 hours) of accumulated moderate-intensity PA or 75 to 150 mins (1¼ to 2½ hours) of vigorous-intensity PA, or an equivalent combination of	Weekly: 150–300 mins moderate PA; 75–150 mins vigorous PA. For health benefits: consider volume increasing beyond the minimum recommended weekly minutes.

Additional benefits (dose-response): 300 mins per week moderate or 150 mins per week vigorous.	both moderate + vigorous activities	
Muscle strengthening: 15 mins specific muscle strengthening daily.	Muscle strengthening: at least twice weekly.	Muscle strengthening: twice or more days minimum weekly, of major muscle groups.
Aerobic exercise performed in bouts of 10 mins duration, accumulated total in 10 to 15 min bouts.	For previously inactive, start by doing some, and gradually build up to the recommended amount.	Aerobic exercise performed in bouts of 10 mins duration minimum.
- Progressive increase in the intensity of exercise for those previously inactive.		
Recommended brisk walking and dynamic yoga encouraged; categorised what modalities of PA may be considered moderate and vigorous.		

Note. PA = physical activity. Information from consensus physical activity guidelines for Asian Indians (Misra et al., 2009; Misra et al., 2012); Australian physical activity guidelines for adults 18 to 64 years (Australian Department of Health and Aged Care, 2021); and international physical activity guidelines for adults (Bull et al., 2020; World Health Organization, 2020).

Health within the spectrum of activity levels

Physical activity and sedentary behaviour including sleep represent the full range or spectrum of activity levels which, when balanced appropriately, contribute to achieving the highest possible health benefits (Australian Department of Health and Aged Care, 2021; Pedišić, 2014; van der Ploeg & Hillsdon, 2017). As such, a combination of regular physical activity and limiting sedentary behaviour and sleep is essential for optimal health (Pedišić, 2014). From prospective cohorts, it is known that the greatest health risks are faced by individuals who are inactive and sedentary (Matthews et al., 2016). This positions Asian Indian migrants who are largely physically inactive and sedentary at the peak risk of poor lifestyle-health-related outcomes (Babakus & Thompson, 2012; Crespo et al., 2000; Fischbacher et al., 2004).

1.2. Thesis rationale

Indians have low levels of physical activity in their country of origin (Anjana et al., 2014; Sullivan et al., 2011) and as migrants in high-income countries such as the United Kingdom (UK), the United States (US), Canada, New Zealand (Babakus & Thompson, 2012), and Australia (Mahajan & Bermingham, 2004). Currently, following English people, Indians are the largest migrant community in Australia, surpassing the Chinese (Australian Bureau of Statistics, 2023). Given

their rising numbers, increasing their level of physical activity is an important solution to the global disease burden accruing through the early onset of NCDs.

In Australia, the reasons for inactivity, obesity, and diabetes among Asian Indians are multifactorial (Fernandez, Everett, et al., 2015). Examining diverse contextual influences on physical activity participation can help address some of these health risks. Research by Holdsworth et al. (2017) stressed the importance of exploring diverse contextual factors that influence the physical activity behaviours of ethnic migrants living in Europe. Their work identified eight distinct contextual domains which explicitly include migration, alongside other domains, for example sociocultural settings, social and material resources, physical environment and opportunity, health and health communication, occupational settings, psychosocial, and political environments (Holdsworth et al., 2017). Such diverse contextual influences remain under-researched for Asian Indian migrants globally and in Australia. Previous qualitative work on Indians in Australia has highlighted the need to prioritise the social and cultural contexts (links to cultural identities/cultural norms) as potential influences when understanding physical activity participation for this group (Gupta et al., 2017). Such culturally specific measures have yet to be developed.

Understanding how physical activity levels change between their host country and country of origin, along with the contextual factors influencing these changes, can provide crucial insights when capturing the full scope of their physical activity behaviours and practices. Only one comparative study shows Indians have low physical activity levels after migration to Australia, but the underlying reasons for such results were unexplored (Mahajan & Bermingham, 2004). Comparisons between country of origin and migrant host country are currently unavailable in physical activity research studies. Designing an instrument to compare levels of physical activity and key contextual influences between Australia as the migrant host country and India as the country of origin would not only identify critical contextual factors that influence physical activity participation but also provide comprehensive data on how these factors change from before to after migration. First, it would identify critical contextual factors influencing physical activity participation, such as age, gender, cultural preferences, availability of facilities, social support systems, and any other emerging barriers. Furthermore, understanding these shifts in physical activity participation and the underlying contextual influences could highlight specific factors that either facilitate or hinder migrants' ability to maintain or enhance their lifestyle behaviours in their host country. For example, cultural preferences for certain types of physical activities may not align with those commonly available or practised in the host country. Migrants may face challenges in accessing and engaging with culturally relevant sport or physical activity

opportunities, which could hinder their integration into local communities or their overall well-being.

The translation of findings into practice requires knowledge of current practice. Drawing from such evidence, data-driven policy recommendations could be developed to support the inclusion of migrants through physical activity initiatives. For example, local governments could tailor their initiatives to better support the sporting preferences of their migrant communities, ensuring that their traditional and cultural needs and interests are reflected in community offerings. In areas with high populations of Asian Indians in Australia, such as Melbourne in the state of Victoria, such findings could inform local policy agendas focused on inclusive sporting opportunities. By considering these contextual factors in the design and implementation of policies, local authorities could help ensure more equitable access and opportunities for migrant populations to engage in physical activity, facilitating their social integration in Australia and improving public health outcomes.

A note on the use of terminology: The remainder of the thesis refers to 'Asian Indian migrants' as 'Indian migrants'. The phrase 'Asian Indian' is solely retained within the chapter headings for consistency with the titles of published articles.[1]

1.3. Positionality

My position as an insider leading this research stems from identifying the intersection of cultural background, migrant identity, and lived experiences of India and Australia with those of the study participants. My perspectives are shaped by my past and present roles, particularly within the sport and recreational sectors across both countries. These shared elements, while advantageous to my understanding of cultural nuances and fostering participants' trust and my rapport with them, also carry the potential for biases and assumptions that must be managed carefully.

As lead researcher, I was mindful of approaching these interviews with an awareness of my migrant journey and experiences of these contextual domains. As best as possible, I tried to maintain an objective stance in reporting participant experiences through direct quotes presented in Chapters 4 and 5 and excerpts in the policy study in Chapter 8. After each interview,

[1] In this thesis, the text in published manuscripts has been amended from American to Australian English spellings throughout.

I verbally reviewed my notes with each participant to ensure their experiences were accurately captured.

I also engaged in reflexive practice using a journal to bring about an awareness of how my experiences and values influenced various stages of this research. For example, I focused on the leisure domain of physical activity, and sport participation, assuming physical activity and sport to be preferred avenues for migrants to form social connections and engage in physical activity. Through journaling, however, I was able to critically examine how much of my approach was shaped by personal assumptions versus the perspectives of participants or the broader literature. Such use of reflexivity is encouraged to document methodological and contextual decisions, including the framing of research aims noting personal expectations, any disagreements, and assumptions held (Olmos-Vega et al., 2023).

The supervision team

The diverse professional and cultural backgrounds, disciplinary expertise, and academic skills of the research team members helped mitigate biases introduced by my positionality. The team, comprising individuals of New Zealand European origin, and coauthors from Australia, brought expertise in areas of public health, medical anthropology, social justice, health equity, sport, and physical activity, with both qualitative and quantitative research expertise that complemented the methodology. Their perspectives challenged and refined my assumptions, especially in interpreting and reporting findings, and provided essential balance to the research design and analysis. The inclusion of team members with an outsider lens was crucial to bringing rigour and integrity throughout the research process. Ultimately, the integration of my insider position with the team's expertise enabled a nuanced exploration of the thesis research questions outlined next.

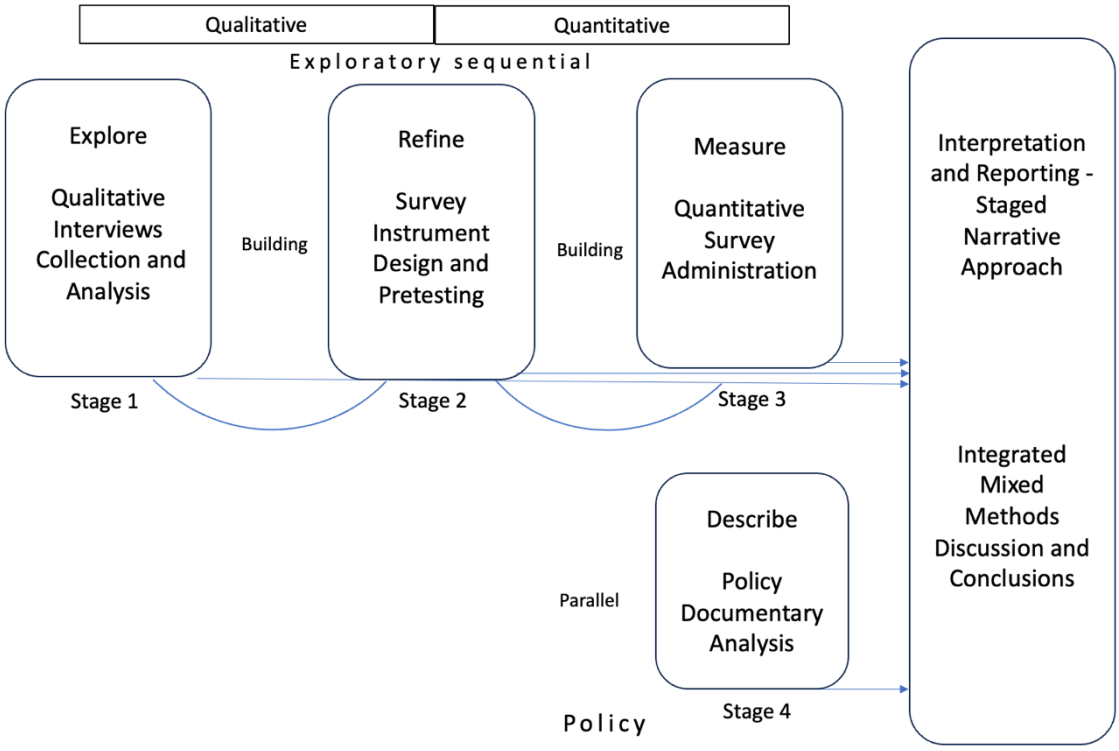
1.4. Thesis research question and aims

The overarching research question addressed in this research study was, how do key contextual factors relate to experiences of physical activity and sedentary behaviour among Indian migrants living in Australia? This research study aimed to: 1) critically explore and measure key contextual factors (e.g., sociocultural) associated with the patterns of sport, physical activity, and sedentary behaviour among Indian migrants living in Australia, and 2) triangulate evidence-based insights to inform and tailor policy recommendations that promote equitable access and opportunities for migrant participation in sport, physical activity, and sedentary behaviour in Australia.

1.5. Study outline and specific objectives

This research project adopts a multistage mixed-methods research framework that includes a series of data collection stages conducted across four studies (see Figure 1, below) (Fetters et al., 2013). With its flexible, iterative design, a multistage framework draws in qualitative insights in combination with quantitative components through various mixed-methods research designs applied to multiple phases over single studies (Almeida, 2018). The first three studies follow an exploratory sequential design (Creswell & Creswell, 2017), starting with an initial literature search that identified and synthesised existing empirical research to inform both the qualitative and the quantitative studies. A second search gathered documents for the final policy study. The rationale was that the first qualitative study would explore and understand perspectives and experiences (from pre- to post-migration), and identify key concepts and contextual factors influencing physical activity and sedentary behaviour (Creswell & Creswell, 2017). These qualitative insights would inform the modification of a culturally appropriate quantitative survey performed as the second study. In the third study, this survey was administered to a wider Indian migrant population to identify and measure the key contextual factors quantitatively. Study Three built on the insights from Study One, expanding the understanding of contextual influences on physical activity and sport participation within the context of migration from India to Australia. The fourth and final study used a parallel approach and examined policy documents to understand their implications for promoting the participation of migrant communities in physical activity. Comparing existing policy documents across levels of Australian Government to promote and foster the inclusion of and equity for migrants in Australia, this final study expanded on the insights into the phenomenon of physical activity and sport participation. Figure 1, below, is a visualisation of this research design. Following on from the figure, the research questions and aims for each study are outlined.

Figure 1 *Multistage Mixed-Method Framework*



Note. The blue curved arrows represent the sequential component. The blue straight arrows denote independent studies and their findings. These findings are integrated into the thesis discussion/conclusion across the overarching multistage research framework. Adapted from Fetters et al. (2013).

Study One. Qualitative data collection and analysis

Research sub-question: *What are the perspectives on physical activity and sedentary behaviour, and what key contextual factors influence participation in physical activity and sedentary behaviour among Indian migrants residing in Australia?*

Aim 1. To identify how Indian migrants living in Australia define physical activity and sedentary behaviour, and to describe how these definitions are shaped by cultural background and migration.

Aim 2. To explore the range of contextual factors that influence physical activity and sedentary behaviour among Indian migrants living in Australia.

Study Two. Survey instrument design and pretesting

Research sub-question: *What key constructs, scales and items represent the qualitative data from Study One?*

Aim. To refine and develop a culturally appropriate survey instrument and to test its face validity.

Study Three. Quantitative data collection and analysis

Research sub-question: *What is the association between sociocultural factors and overall sport and physical activity levels among Indian migrants living in Australia, pre- and post-migration?*

Aim 1. To determine the change in physical activity levels and type of physical activity from pre- to post-migration.

Aim 2. To analyse key sociocultural factors associated with changes in physical activity levels from pre- to post-migration

Study Four. Policy documentary analysis

Research sub-question: *What is the contextual landscape of sport and physical activity policies in Australia, and how do these policies address the inclusion of migrants and promote equitable access and opportunities for their participation in and through sport and physical activity in Australia?*

Aim 1. To explore the role of written policies in promoting favourable contextual factors and promoting the inclusion of migrants in sport and physical activity.

Aim 2. To compare policy approaches across different government levels, with a focus on local government areas in Victoria with large Indian populations.

1.6. Thesis structure

Chapters 1 - 3: Introductory chapters

As illustrated in Figure 2, below, this thesis contains a total of nine chapters. This current chapter constitutes the opening chapter.

Chapter 2 reviews the literature for Indian populations examining their levels of prevalence of physical activity and sedentary behaviour as well as contextual influences on these behaviours both when living locally in India and as migrants globally. A general overview of measurement tools and frameworks commonly used in physical activity research is outlined, and the chapter concludes with a critical summary of literature gaps, setting the stage for the thesis aims and methodology.

Chapter 3 presents the philosophical and methodological justifications for a multistage research framework with details on the exploratory sequential design and the policy study.

Chapters 4 - 8: Staged approach to presenting results[2]

Chapters 4- 8 follow a staged approach to presenting the results since the data from each stage were analysed and published separately as individual studies. These chapters are formatted as manuscripts as follows:

- Chapters 4 - 5 present the published findings from the qualitative phase. Chapter 4 specifically addresses how physical activity and sedentary behaviour are defined by Indian migrants living in Australia, and how these definitions are shaped by cultural background and migration. Details of the publication of this work in *BMC Public Health* are provided at the beginning of the chapter. Chapter 5 explores the contextual factors influencing physical activity and sedentary behaviour among Indian migrants living in Australia. This chapter was published in the *Journal of Physical Activity and Public Health*.[3]
- Chapter 6, covering Study Two, addresses the absence of context-specific measures for physical activity among Indian migrants. This chapter, drafted as a manuscript, outlines how the integration of key concepts from qualitative inquiry, discussed in Chapter 5, informs the development of a culturally tailored survey instrument. The goal of this survey was to assess key contextual influences, particularly sociocultural correlates, on physical activity participation among Indian migrants. Additionally, the chapter highlights the process of refining and pretesting this instrument to ensure its relevance and accuracy in capturing the factors that influence physical activity in this specific population.

[2] Some repetition may occur between the manuscript chapters and the final conclusion Chapter 9.
[3] Note: Minor formatting changes were made to the published manuscripts, Chapters 4-5, to align them with the formatting of the overall thesis.

- Chapter 7, covering Study Three, the quantitative phase, reports on the examination of the association between sociocultural correlates and overall sport and physical activity participation before and after migration among Indian migrants living in Australia.
- Chapter 8 presents details of the document analysis exploring the policy context of sport and physical activity across federal, state, and local government levels in Australia. The chapter includes comparisons across these levels, with a particular focus on the involvement of Indian migrant populations in local government areas within the state of Victoria.

Chapter 9: Conclusion and recommendations

Chapter 9 takes the integrated narrative approach using weaving (Fetters et al., 2013) to present the discussion and reporting of findings from the qualitative and quantitative phases and policy analysis, presenting these across key themes. This chapter offers novel contributions to empirical knowledge, provides conclusive policy recommendations, discusses the strengths and limitations of the overall research, and puts forward suggestions for future exploration.

Figure 2 *Thesis Structure*



1.7. Summary

This opening chapter outlined the importance of understanding physical activity and sedentary behaviour among South Asian migrant populations, particularly Indian migrants in Australia. It introduced the research questions and corresponding aims, the research design, and the team's positionality in designing and conducting this research project. The next chapter reviews the literature, identifying research gaps and explaining how the findings from each study address these gaps.

CHAPTER 2. LITERATURE REVIEW

2.1. Introduction

This chapter provides a comprehensive and critical summary of the literature on physical activity and sedentary behaviour participation among the Indian population. It adopts an integrative approach to synthesise findings from diverse research designs and approaches (philosophies) employing qualitative and quantitative studies. An integrative approach can offer a holistic understanding of the research evidence on participatory behaviours and practices which can better translate into the development of policies and practices (Dhollande et al., 2021) on physical activity and sedentary behaviour among Indians. This approach included understanding the advantages and limitations of different assessment methods for correctly interpreting the prevalence statistics for the Indian population and in the context of migration.

Conceptual framework

Previous models and frameworks related to influences on physical activity and sedentary behaviour, which explicitly consider migration, are outlined in section 2.5. These were reviewed to support the identification and classification of factors influencing these behaviours. The diverse contextual clusters (referred to here as 'contextual domains') formulated by Holdsworth et al. (2017) presented an appropriate foundation for exploring a range of contextual influences on physical activity and sedentary behaviour among Indian migrants in Australia. These contextual domains offer a structured approach to guide the identification, classification, and discussion of a broad range of contextual influences identified across the reviewed qualitative and cross-sectional studies presented.

Review questions

This review of literature aimed to identify, critically analyse and synthesise current research on physical activity and sedentary behaviour and the key correlates that influence these behaviours among the Indian population. The key research questions were:

1) What is known about the levels of physical activity and sedentary behaviour of Indian populations when living in their country of origin and as migrants in high-income host countries?

2) What are the diverse contextual influences on physical activity and sedentary behaviour among Indian migrants?

Specific aims

To outline and describe the overall physical activity and sedentary behaviour prevalence levels among Indians in India, i.e., their country of origin, and as migrants in high-income host countries.

To identify and briefly discuss key contextual factors influencing these participatory behaviours and practices of Indians as migrants in high-income host countries.

To provide an overview of physical activity measurement techniques used in migrant populations.

The purpose of this review was to identify and select relevant empirical qualitative and quantitative research studies. These findings are presented in the "Results" section 2.3 separately for qualitative and quantitative studies as follows: Findings drawn from quantitative studies are presented as two sub-sections: a *local* section, summarising the prevalence (levels) of physical activity and sedentary behaviour among Indians in their country of origin, and a *global* section, summarising the prevalence of physical activity and sedentary behaviour among the Indian diaspora residing in high-income host countries. Findings from the qualitative studies are presented under section 2.3.2 summarising the influences on physical activity and sedentary behaviour among Indian migrants. The chapter concludes with a critical summary, highlighting key gaps in the literature that the thesis seeks to address through its research questions outlined in Chapter 1.

2.2. Literature search criteria and methods

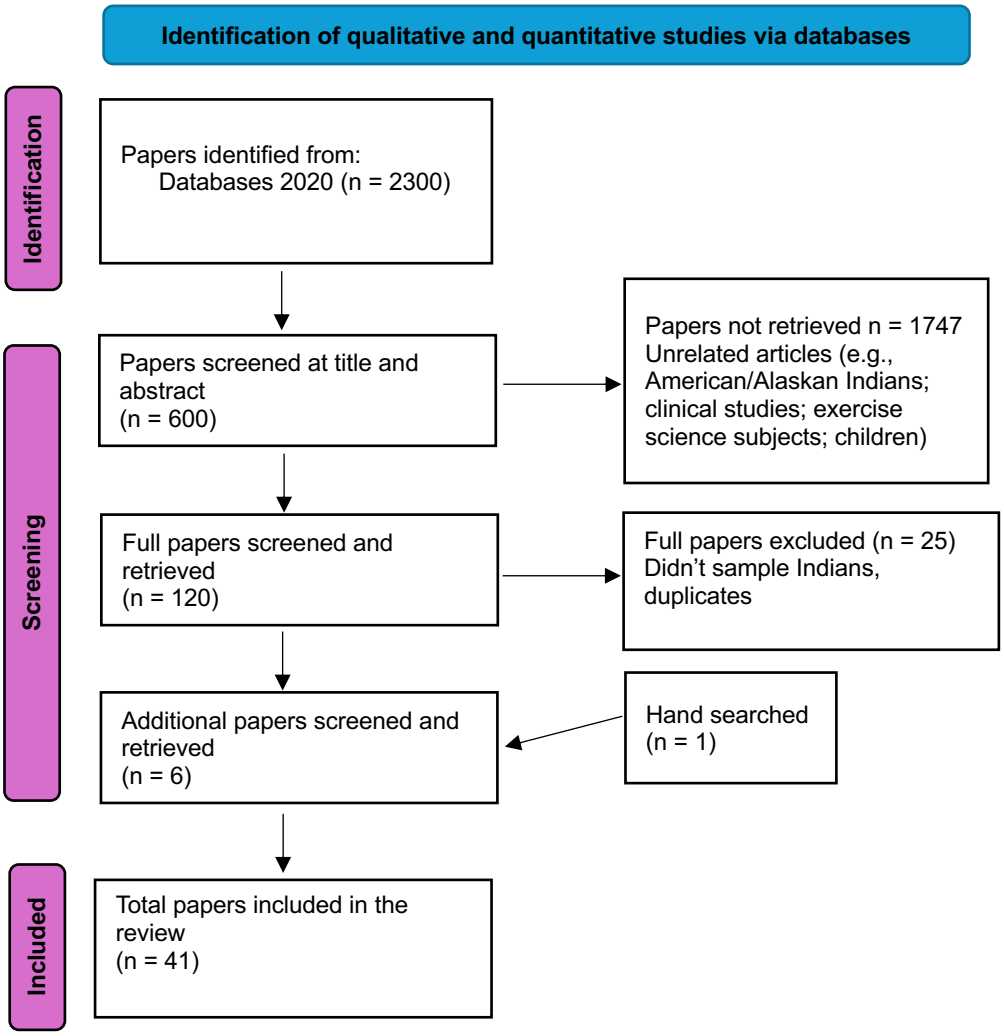
Two distinct searches were performed to identify the relevant and existing research evidence to support both the sequential component across Study One to Study Three, and to identify the documents necessary for the final policy study, Study Four. The reporting of the literature review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2010). Figure 3 visually presents the search results for the exploratory sequential qualitative and quantitative studies described within this chapter. Description of the search methods and results for the policy study (Study Four) are detailed in Chapter 8.

Study One to Study Three: Exploratory sequential studies

An initial search of the international literature was performed to identify relevant peer-reviewed empirical qualitative and quantitative studies with Indian migrants as the focus. Specifically, the search was conducted to identify the level of physical activity and sedentary behaviour participation, the contextual influences and the corresponding instruments used to measure the contextual domains. This search included published peer-reviewed journal articles written in English and focused on healthy Asian Indian adults aged 18 years and above, both within India and globally. No restrictions were set for sample size or year of publication. Excluded studies did not specifically address Indian populations within the sample or involved populations from countries other than India, such as Fijian Indians, Alaskan/American Indians; studies that involved clinical populations with chronic illnesses or physical disabilities that would prevent participation in physical activity were also excluded.

This search was performed in academic databases, namely Scopus, Medline via PubMed, CINAHL Complete, and SPORTDiscus via EBSCOhost. The search employed a combination of keywords: 'physical activity', 'sedentary behaviour', 'Indian', 'leisure activities', 'sport', 'exercise', 'fitness', and 'recreation'. The keywords 'physical activity', and 'sport', were combined with migrant descriptors for example, 'Asian' [Mesh], 'South Asian People' [Mesh], 'India' or 'Indian', 'Asian Indian' and contextual keywords. Using truncations for keywords at their basic word stems within the search ensured the inclusion of their associated items. No restrictions were imposed on the publication date. This search took place in 2019 before the commencement of the qualitative phase as the first study of the thesis.

Figure 3 *PRISMA Flow Diagram*



Note. The figure represents the flow of information through the different phases of a literature review. This figure is adapted from the flow diagram proposed by Moher et al. (2010).

2.3. Results

Of the 41 papers retrieved, six studies were conducted in India. Of these, one qualitative study used interviews, and the remaining five quantitative studies used surveys or questionnaires.

Of the remaining 35 papers retrieved on Indian migrants, 16 were quantitative studies and 19 were qualitative studies. Among the quantitative studies, 12 used surveys or questionnaires, two studies only used objective measures, one study combined objective measures with a self-report questionnaire and one study used physical activity recall logs and diaries. Among the qualitative studies, nine used interviews, seven studies used focus groups, and three studies combined both methods. The majority of these studies were undertaken in the US (*n=11*), followed by nine

studies in the UK, six in Canada, six in Australia, and one study each in New Zealand, Scotland, and Guadeloupe.

Levels of physical activity and sedentary behaviour among Indian populations

This section consists of two sub-sections. The *local* section outlines the overall physical activity and sedentary behaviour prevalence levels among Indians in India, i.e., their country of origin. The *global* section describes these participatory behaviours and practices of Indians as 'migrants' in the US, UK, Guadeloupe and Australia. Summary tables for the local and global sections are available in Appendix D and Appendix E respectively.

Prevalence of physical activity and sedentary behaviour and practices in India

Self-report data examining the physical activity patterns in India identified the majority of the Indian population had low levels of physical activity, consistently showing men to be more active than women (Anjana et al., 2014; Sullivan et al., 2011; Vaz & Bharathi, 2004). Participants in the Indian Council Medical Research (ICMR)-INDIAB study represented four diverse states: Chandigarh (in the north of India), Tamil Nadu (south), Jharkhand (east), Maharashtra (west) (Anjana et al., 2014). That study involved a total of 14,227 Indian men and women and found 54.4% of these participants were inactive. State-wise, the proportion of inactivity was greatest for the state of Chandigarh (67%), followed by Tamil Nadu (60%), and Maharashtra (52%) with Jharkhand reporting the lowest proportion of inactivity (35%) (Anjana et al., 2014). Urban residents had a significantly greater proportion of inactivity compared to rural residents (urban 65%; rural residents 50%, $p < 0.001$) (Anjana et al., 2014).

Of the 31% who were active and 13.7% highly active, the majority were men (58.3% active, 61.3% highly active) (Anjana et al., 2014). When examining correlates of socio-demographic variables on active travel, time spent on total physical activity (>150 mins as the recommended levels of physical activity) was significantly greater for residents from Chennai than for residents from Goa (1,285 ± 1164 and 612 ± 815 mean min/wk respectively, $p < 0.001$) (McKay et al., 2015). Anjana et al. (2014) reported the greatest proportion of physical activity for residents from Jharkhand followed by residents from Maharashtra, Tamil Nadu and Chandigarh. Rural residents spent greater time on moderate-to-vigorous physical activity than urban residents (rural: 142 min/day; urban 79 min/day) (Sullivan et al., 2011).

Age and gender also determine the physical activity participatory behaviours among Indians (Vaz & Bharathi, 2004). For instance, total physical activity was greatest in men aged between 17 to

24 years (1.64 ± 0.21 MET-min/day) and women aged 25 to 35 years (1.56 ± 0.15 MET-min/day). The lowest levels of physical activity were observed among older Indians aged 58 years and above (men: 1.22 ± 0.07 MET-min/day; women: 1.30 ± 0.13 MET-min/day) (Vaz & Bharathi, 2004).

Overall, participation in leisure-related physical activity behaviours was low, particularly among women (Anjana et al., 2014; Sullivan et al., 2012). Only those who performed 20 minutes of leisure-related physical activity per day were considered active (Anjana et al., 2014). Regionally (state-wise), the percentages of people physically inactive during leisure time were 88% in Chandigarh, 91% in Maharashtra, 93% in Tamil Nadu, and 95% in Jharkhand (Anjana et al., 2014).

Domain-specific self-report questionnaires revealed that Indian men and women mainly acquired their physical activity through occupational, household, and active travel behaviours, rather than leisure or 'exercise' (Anjana et al., 2014; McKay et al., 2015; Sullivan et al., 2011; Vaz & Bharathi, 2004). Indian men typically participated in manual-labour-related tasks, thereby gaining greater physical activity levels in the occupational domain, while Indian women engaged in greater housework (Vaz & Bharathi, 2004). A self-administered questionnaire in a convenience sample of 782 adult men and women aged 17 years to 70 years in the South Indian city of Bangalore found that women perceived activities such as jogging, uphill walking, and carpentry as higher intensity physical activity compared to men, while men perceived housework-related physical activity (sweeping, washing clothes) as higher intensity activities compared to women (Vaz & Bharathi, 2004).

Two studies using the Global Physical Activity Questionnaire (GPAQ) identified most time spent on physical activity was accrued through active travel and work-related physical activity compared to leisure-related physical activity, and this varied between different regions in India (Anjana et al., 2014; McKay et al., 2015). In the ICMR-INDIAB study, time spent on active travel was greatest for the state of Jharkhand, compared to Chandigarh, Maharashtra and Tamil Nadu (20, 13, 12 and 12 mean min/day respectively) (Anjana et al., 2014). The study by McKay et al. (2015) found time spent on work-related physical activity was significantly greater among residents from Chennai (1,011 ± 1103 mean min/wk, $p < 0.001$) than residents from Goa (259 ± 660 mean min/wk, $p < 0.001$). Active travel was greatest among residents from Goa (Western India), and least in Chennai (South India) (312 ± 445 and 226 ± 285 mean min/wk respectively, $p < 0.001$) (McKay et al., 2015). Time spent on leisure was significantly lower in Chennai and Goa than in other domains (52 ± 208 and 41 ± 166 mean min/wk respectively, $p < 0.001$) (McKay et al., 2015).

Very little is known about sedentary behaviour among adults in India. Using the Indian Migration Study Physical Activity Questionnaire (IMS-PAQ), Sullivan et al. (2011) observed that the majority of the Indian population spent more time on sedentary activities than on light and moderate-to-vigorous physical activity (sedentary 475 min/day; light 370 min/day; moderate/vigorous 95 min/day $p < 0.001$). Overall, Indians from urban areas had the most overall sedentary time of 508 min/day followed by rural-urban residents with 491 min/day, with those residing in rural areas having the least at 421 min/day (Sullivan et al., 2011). These sedentary times also differed by gender between urban, rural-urban, and rural regions. Both men and women from rural regions spent significantly less time on television viewing (women: 17 min/day; men: 15 min/day), compared to urban residents (men: 50 min/day; women: 62 min/day) and rural-urban regions (men: 43 min/day; women: 59 min/day) (Sullivan et al., 2011).

Summary

Leisure-related physical activity is not common in India. Gender and urbanicity accompany varying physical activity practices. Most physical activity stems from domains of occupation, household, and active transport. Authors Vaz and Bharathi (2004) emphasised the need to understand domain-specific behaviours among the Indian populace in regard to physical activity and sedentary behaviour, which only recent studies have considered. Moreover, most physical activity data were collected with self-reported measures, which might be culturally unsuitable for the Indian population. Culturally appropriate survey tools for assessing physical activity and sedentary behaviour may be essential for obtaining findings on physical activity and sedentary behaviour among Indians. Regional variations that might be explained by cultural differences underscore the importance of having a culturally representative sample when conducting research involving Indian populations (Anjana et al., 2014).

Prevalence of physical activity and sedentary behaviour among Indian migrants

The majority of the research targeting Indian migrants has been conducted in the US (Daniel, Wilbur, Marquez, et al., 2013; Jonnalagadda & Diwan, 2002; Joseph & Bishop, 2015; Misra et al., 2005) Several other studies conducted in the UK combine Indian migrants with other diverse South Asian populations such as Bangladeshi and Pakistani migrants (Hayes et al., 2002; Williams et al., 2011). A few studies from other countries, including Guadeloupe (Sinnapah et al., 2009) and Australia (Fernandez, Rolley, et al., 2015; Mahajan & Bermingham, 2004), also explored Indian migrant populations. Findings specific to Indian migrants are outlined below.

Overall physical activity levels among Indian migrants

The literature consistently suggests that Indian migrants, particularly Indian migrant women, have low physical activity levels (Daniel, Wilbur, Marquez, et al., 2013; Fernandez, Rolley, et al., 2015; Hayes et al., 2002; Joseph & Bishop, 2015; Mahajan & Bermingham, 2004; Misra et al., 2005; Sinnapah et al., 2009; Williams et al., 2011). Population-based surveys in the UK identified time spent on physical activity was greater among Indian migrant men than among Indian migrant women (Hayes et al., 2002; Williams et al., 2011). However, these amounts were lower when compared to the British general population (Indian men: 1,089 mean MET-min/wk; Indian women: 919.41 mean MET-min/wk; British men: 1,672.05 mean MET-min/wk; British women: 1,292.67 mean MET-min/wk) (Williams et al., 2011).

Similarly, in the US and Guadeloupe, Indian migrants had lower physical activity levels than the general population (Daniel, Wilbur, Marquez, et al., 2013; Sinnapah et al., 2009). Device-based measures using an accelerometer to assess physical activity found Indian migrants in the US had a low daily average step count of 6,904.3, with Indian migrant men having slightly higher step counts (men: 7056.6 steps/day; women: 6813.8 steps/day) (Daniel, Wilbur, Marquez, et al., 2013). The International Physical Activity Questionnaire – Long Version (IPAQ-L) self-report measure used in a women-only study identified that Indian migrant women in the US had low physical activity across all domains (55.96 median MET-hrs/week) (Joseph & Bishop, 2015). In Guadeloupe, Indian migrant men and women were less active, compared to host Caribbean and African islanders (Indian men: 1.45 ± 0.12; Indian women: 1.62 ± 0.22; host nation men: 1.64 ± 0.33; host nation women: 1.74 ± 0.34, $p < 0.05$) (Sinnapah et al., 2009). In that study, physical activity was calculated as an index, with an equation based on energy expenditure and basal metabolic rate.

In Australia, the majority of Indian migrants do not meet the country-specific physical activity guidelines which recommend > 150 to 300 minutes of moderate-to-vigorous physical activity per week (Fernandez, Rolley, et al., 2015). Only two studies reported low physical activity levels among Indian migrants (Fernandez, Rolley, et al., 2015; Mahajan & Bermingham, 2004). Mahajan and Bermingham conducted a cross-sectional, inter-country comparative survey-based study and found that total time spent on physical activity, expressed in hours per two weeks, was greater among Indians living in India than Indians living in Australia (India: 23.7 ± 32.7 hr/two weeks; Australia: 17.2 ± 23.2 hr/two weeks) (Mahajan & Bermingham, 2004). The total time spent on physical activity was significantly greater for women living in India than in Australia (India: 33.5 ± 36.9 hr/two weeks; Australia: 17.1 ± 20.6 hr/two weeks, $p < 0.001$) (Mahajan & Bermingham, 2004).

In the UK, overall physical activity varied across culturally diverse South Asian groups (Williams et al., 2011). The National Health Survey for England found Indian migrant men had greater total physical activity than Pakistani and Bangladeshi men, but lower than the British general population (British: 1,672 mean MET-min/wk; Indian: 1,089 mean MET-min/wk; Bangladeshi: 1,055 mean MET-min/wk; Pakistani: 974 mean MET-min/wk) (Williams et al., 2011). Total physical activity of Indian migrant women was lower than British and Pakistani women, but higher when compared to Bangladeshi women (British: 1,293 mean MET-min/wk; Pakistani: 926 mean MET-min/wk; Indian: 919 mean MET-min/wk; Bangladeshi: 775 MET-min/wk) (Williams et al., 2011).

In the US, physical activity levels varied among Indian migrants from diverse native regional origins in south, north and west India (Jonnalagadda & Diwan, 2002). A greater proportion of Indian migrants originating from southern India participated in physical activity 3 to 4 days a week compared to Indian migrants from western and northern Indian origins (south, 70%; north, 56%; west, 65%) (Jonnalagadda & Diwan, 2002). The authors implied migrants from northern Indian origins are likely to be at a greater risk of inactivity than those from other regions (Jonnalagadda & Diwan, 2002). While further research is needed to confirm these findings, similar regional variations in physical activity have been observed among Indians in their country of origin (Anjana et al., 2014; McKay et al., 2015). These insights highlight the importance of using a culturally representative sample in research involving Indian populations.

Leisure-time physical activity behaviours and practices

In the US, UK, and Guadeloupe, walking was commonly reported among Indian migrant men and women (Daniel, Wilbur, Marquez, et al., 2013; Hayes et al., 2002; Joseph & Bishop, 2015; Misra et al., 2005; Sinnapah et al., 2009). In Guadeloupe, the domain for walking was not reported (Sinnapah et al., 2009).

In the US, one study, using the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire (Stewart et al., 2001), found that 51.8% of Indian migrants performed leisure activities to meet the country-specific guidelines (Daniel, Wilbur, Marquez, et al., 2013). The study found no significant gender differences in total time spent on leisure-time physical activity. However, slightly greater times were reported for Indian women (women: 510.2 mean min/wk; men: 381.9 mean min/wk) (Daniel, Wilbur, Marquez, et al., 2013). By contrast, another study using the Minnesota leisure time physical activity questionnaire found total time spent on

leisure activity was greater among Indian migrant men (men: 533 ± 445.7 activity metabolic index (AMI)/wk; women 203.5 ± 265.5 AMI/wk) (Misra et al., 2005).

In the UK and the US, Indian migrants who engaged in 'exercise' and sport joined health clubs and participated in tennis, golf, swimming and cycling (Hayes et al., 2002; Misra et al., 2005). Indian migrant men in the US participated in a variety of sports, such as cycling, swimming, hiking, tennis, volleyball, golf, cricket, and basketball, that differed from those engaged in by Indian migrant women, who preferred cross-country skiing, hiking, and mountain biking (Misra et al., 2005). In the UK, the survey used in the New Castle Health Project, a cross-sectional population-based study, reported that Indian migrant women mainly preferred swimming (Hayes et al., 2002). The study reported similar preferences for Indian migrant men and European (i.e., English and Welsh) men with both groups choosing swimming, and football or rugby. However, Pakistani and Bangladeshi men preferred tennis and badminton over football/rugby and swimming (Hayes et al., 2002). Women from all South Asian subgroups preferred swimming, as did the European (i.e., English and Welsh) women of the UK's general populace, who also chose dancing. In contrast to South Asian and European men, none of these women participated in football or rugby. In the US, participation in home-based activities such as gardening and home repairs was more often found among Indian men than Indian women (Misra et al., 2005), and both preferred taking stairs as a form of exercise over engaging in heavy-intensity exercises (Misra et al., 2005).

Indian migrants differed from other South Asian migrants in their walking and cycling practices (Hayes et al., 2002). For example, data from a UK cross-sectional survey found that the proportion of Indian migrant men cycling less than two miles on both weekdays and weekends was greater than Pakistani and Bangladeshi men (Indian men: weekdays, 3.8%; weekends, 2.8%) (Hayes et al., 2002). The proportion of Indian migrant men cycling less than two miles on weekdays and weekends was also greater than English and Welsh men (weekdays, 3.6%; weekends, 2.2%). Similarly, the proportion of Indian migrant women cycling on weekends was greater than European and Pakistani women (women, weekends: Indian, 4.5%; European, 2.1%; Pakistani 1.4%). Neither Bangladeshi men nor women engaged in cycling on weekdays or weekends (Hayes et al., 2002).

Similar sub-group variations were also found for walking practices. The average proportion of men walking less than a mile during weekdays was higher among Pakistani men than among Indian, Bangladeshi, English, and Welsh European men. Specifically, 60% of Pakistani men reported walking less than a mile, compared to 57.1% of Indian men, 50% of Bangladeshi men,

and 32.2% of European men (Hayes et al., 2002). A greater proportion of Pakistani and Bangladeshi migrant women walked on weekdays compared to Indian migrant women and European women (women, weekdays: Pakistani, 52%; Bangladeshi, 48%; Indian, 44%, European, 37%). On weekends, the proportion of women walking was greatest for Pakistani women, followed by Indian women, Bangladeshi women, and European women (women, weekends: Pakistani, 72%; Indian, 63%; Bangladeshi, 48%; European, 28%) (Hayes et al., 2002).

In Australia, little is known about the physical activity behaviours and practices of Indian migrants (Fernandez, Rolley, et al., 2015; Mahajan & Bermingham, 2004). Time spent walking was greater among Indian women living in India than Indian women living in Australia (women, walking: India, 9.2 ± 9.18 hrs/two weeks; Australia, 4.8 ± 5.3 hrs/two weeks; $p < 0.01$) (Mahajan & Bermingham, 2004) which may explain the greater physical activity levels found among Indian women in India over their Australian counterparts. In both countries, there were no differences in walking behaviours among Indian men (men, walking: India, 5.8 ± 9.4 hrs/two weeks; Australia, 4.3 ± 6.3 hrs/two weeks) (Mahajan & Bermingham, 2004). These results indicated that, as migrants, Indian women are less active in Australia than in India. The context for walking was not reported.

A 2010 study of 139 Indians living in Australia used the Active Australia survey to assess "exercise behaviours," though only walking behaviour was reported (Fernandez, Rolley, et al., 2015). The survey was administered to Indian migrant men and women who attended a health promotion activity stall at an Australia–India friendship fair. The study found that only 37% of Indian migrants met the physical activity guidelines of >150 minutes per week (*n=42*), with a higher proportion of women being inactive compared to men (women: 71%; men: 65%) (Fernandez, Rolley, et al., 2015). A small portion of the overall sample (32%, *n=45*) reported walking for travel and leisure purposes, with time spent walking ranging from 20 minutes to 20 hours per week, three to four times a week. Only 30% (*n=42*) reported walking for more than the recommended 150 minutes per week, though the reasons for this outcome were not specified (Fernandez, Rolley, et al., 2015).

Overall, these findings have limited generalisability as the data is drawn from a small proportion of the sample population. The sporting behaviours reported by Indian migrants differed from the physical activities Indians engaged in while living in their country of origin. Cross-country skiing and mountain biking, reported in the US, were not included in the UK population-based surveys where football and rugby were included (Hayes et al., 2002). Whether Indian migrants are inclined to take up sporting behaviours and if they differ from other countries remains unknown

in an Australian context. Considering that the Indian culture favours certain forms of physical activity (e.g., traditional dance and cricket), culturally sensitive instruments to measure leisure time physical activity would be appropriate.

Household-related physical activity behaviours

In the US, household and leisure-time physical activity were assessed together using the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire (Stewart et al., 2001). The study found that Indian migrants spent an average of 362.7 minutes per week on all intensity house-related physical activities, with significantly greater time spent by Indian migrant women than men (women: 410 mean min/wk; men 283.17 mean min/wk, $p < 0.05$) (Daniel, Wilbur, Marquez, et al., 2013). The IPAQ-L, administered to women only, reported mean total physical activity for housework as 6.8 MET hours per week and gardening as 6.9 MET hours per week (Joseph & Bishop, 2015). The least time was spent on vigorous gardening-related physical activity (1.9 MET hours per week) (Joseph & Bishop, 2015). Time spent on light house-related physical activity was greater for Indian migrant women than men (women 342 mean min/wk; men 148 mean min/wk, $p < 0.01$) (Daniel, Wilbur, Marquez, et al., 2013). Time spent on moderate-to-vigorous house-related physical activity was significantly greater among Indian migrant men (men: 135 mean min/wk; women: 68 mean min/wk, $p < 0.05$), with a significantly greater proportion of men performing heavy gardening (Daniel, Wilbur, Marquez, et al., 2013). No vigorous-intensity physical activity for housework was reported in this population. Importantly, none of these questionnaires were culturally valid and reliable for the Indian migrant population. The reliability and validity of the CHAMPS questionnaire were obtained from cultural populations other than Indian migrants. These domain-specific instruments mainly reported household physical activity in the US (Daniel, Wilbur, Marquez, et al., 2013; Joseph & Bishop, 2015), with limited insight into Indian men. Similarly, in the UK the lack of domain-specific scales has hindered understanding of Indian migrant physical activity behaviours.

Occupation-related physical activity behaviours

In the US, the highest proportion of Indian migrants met the guidelines through occupational physical activity (57.3%), compared to household-related activity (51.8%) and leisure-related activity (20%) (Daniel, Wilbur, Marquez, et al., 2013). The 12-month Tecumseh occupational activity questionnaire (Reiff et al., 1967), assessing 16 types of work-related physical activity, found total time spent in the occupational domain to be 2,420 minutes per week (Daniel, Wilbur, Marquez, et al., 2013). Indian migrant women reported slightly more time (2,470 min/wk) than men (2,357 min/wk), but the difference was not significant (Daniel, Wilbur, Marquez, et al.,

2013). The IPAQ-L found the highest physical activity among Indian migrant women in job-related walking and moderate activity (walking: 25.10 mean MET-hr/wk; moderate work: 26.61 mean MET-hr/wk) (Joseph & Bishop, 2015). No men were included in that study (Joseph & Bishop, 2015). Additionally, the validity and reliability of the 12-month Tecumseh occupational activity questionnaire was established only with Caucasian and African American women, not Indian populations.

Active transport/active travel-related physical activity behaviour

Walking to work was most frequently reported by Indian migrant men and women in the US (Daniel, Wilbur, Marquez, et al., 2013). Both worked an average of 40 hours per week, with women working slightly more than men (41 vs. 39 hr/wk). The IPAQ-L reported the least time spent on active travel among Indian migrant women in the US (walking: 1.1 mean MET hr/wk; biking: .01 mean MET hr/wk) (Joseph & Bishop, 2015). The questionnaires used by Daniel, Wilbur, Marquez, et al. (2013) did not assess transport-related physical activity, so data on this domain of physical activity among Indian migrant communities is limited. This contrasts with findings obtained in India, the participants' country of origin, where transport/active travel behaviours accounted for greater physical activity participation. The lack of data on active travel highlights the need for domain-specific measures when assessing physical activity in migrant Indian populations.

Intergenerational physical activity behaviours among Indian migrants

There is limited evidence on intergenerational physical activity patterns among Indian migrants. Most research stems from UK-based studies (Bhatnagar et al., 2015). Self-report data shows second-generation South Asian migrants have greater levels of physical activity than first-generation migrants (Lean et al., 2001; Smith et al., 2012; Williams et al., 2011), though they remain less active when compared to the host (British-European) populations (Lean et al., 2001; Smith et al., 2012). Williams et al. (2011) reported South Asian populations born in the UK spent more time on physical activity than those born overseas, particularly men (South Asian men: 1385 vs 936 MET-min/wk; South Asian women: 973 vs 844 MET-min/wk). From the evidence, it was inferred that second generations may lead more active lifestyles in future when compared to first-generation migrants (Williams et al., 2011). Among second-generation migrants, Smith et al. (2012), using the Health Survey for England, observed improvements only for physical activity, as opposed to smoking, and alcohol in the diet. The reasons for the increase in physical activity remain unknown. After adjusting for age and sex, the odds of being obese were greater for

second-generation Indian migrants when compared to other culturally and linguistically diverse groups (Irish, African, Caribbean, Pakistani, and Bangladeshi) (Smith et al., 2012).

Sedentary behaviour among Indian migrants

Only one US-based study measured sitting time using the IPAQ-L among Indian migrant women, reporting an average of 35.5 hours per week of sitting-related behaviours (Joseph & Bishop, 2015). In the UK, Indians, along with Pakistanis, were found to spend less time in total sitting (22.5 hr/wk; 5.75 ± 2.90 hr/day) (Gill et al., 2011). The understanding of sedentary behaviour and practices remains incomplete for Indian migrants in Australia, as no studies have measured it.

Summary of the prevalence of physical activity and sedentary behaviour among Indian migrant populations

Indian migrants, particularly women, have low levels of physical activity, consistent with the evidence in India. Limited evidence suggests higher physical activity levels among second-generation migrants compared to first-generation migrants. The evidence on their sedentary behaviour is insufficient globally and mostly relies on self-reports. Culturally specific measures are yet to be developed and tailored to understanding the patterns and practices of physical activity and sedentary behaviour among Indian migrants. Further, many of the research findings are derived from leisure physical activity alone, which is not the only domain contextualised to physical activity among Indian migrants. Research in Australia is scarce, but it suggests low physical activity levels may also prevail among Indian migrants. Therefore, understanding the influence of Indian migrants' physical activity and sedentary behaviour is an important next step.

Influences on physical activity and sedentary behaviour among Indian migrant populations

Globally, research on factors influencing physical activity and sedentary behaviour in the Indian migrant population is limited. This review focuses on findings specific to Indian migrants, with less attention given to evidence that collapses findings with other South Asian populations (Dave et al., 2015; Lawton et al., 2006). The scant evidence in Australia has demonstrated the need for some insights to be drawn from one study that included Indians with Sri Lankan migrants (Gupta et al., 2017). Findings from both cross-sectional studies and qualitative studies are briefly discussed, with multiple factors observed to overlap as influences on Indian migrant physical activity behaviours. Summary tables of correlates from cross-sectional studies are provided in Appendix F and Appendix G**.** Less emphasis is given to factors common to other ethnic groups

such as perceptions of the weather, lack of time, and ill health (Booth et al., 1997; Eyler et al., 1998).

Socio-demographic correlates on physical activity practices

In the US, a study that identified correlates of physical activity among middle-aged and older Indian migrants found the frequency of participation in muscle strengthening, flexibility and aerobic exercise was lower with increasing age (50+ years) (Jonnalagadda & Diwan, 2005). No significant correlations were found between income and frequency of physical activity practices (Jonnalagadda & Diwan, 2005). In the UK, socio-economic factors may be more strongly linked to the lower physical activity levels among South Asian communities than among British populations (Williams et al., 2011). This demographic data suggested education and income were greater among Indian migrants than among other South Asian migrant populations, but lower in comparison to British counterparts (Williams et al., 2011). Another UK-based study reported that second-generation Indians had higher levels of education, but whether this influenced their physical activity levels compared to first-generation Indians remains unclear (Smith et al., 2012).

Social and cultural influences on Indian migrants' physical activity behaviour

Perception of the family: Among Indian migrants in the US and Australia, the role of family was linked to low participation in physical activity (Gupta et al., 2017; Kalavar et al., 2005; Mohan et al., 2008; Sawrikar & Muir, 2010). In Australian-based qualitative studies, Indian migrants described their culture as being highly family-oriented, which often led to prioritising time with family members over engaging in physical activities (Mohan et al., 2008; Sawrikar & Muir, 2010). In particular, middle-aged Indian migrant women revealed their traditional gender roles required their commitment to family duties over their physical activity pursuits, which was also found among migrant women from other diverse nationalities (Sawrikar & Muir, 2010). Semi-structured interviews revealed that South Asians often perceived their collectivist cultural values as fostering strong family bonds which, in turn, led to feelings of guilt when pursuing physical activity individually (Gupta et al., 2017). Consequently, any time spent on leisure pursuits was perceived as self-centred (Gupta et al., 2017). In the US, qualitative insights revealed that older migrant Indians above 70 years old, as compared to those aged 66 to 70 years, were less likely to draw on family in support of their participation in physical activity (Kalavar et al., 2005).

Perception of social networks: Punjabi Sikh migrants perceived a lack of social networks as a barrier that limited their previous walking behaviours which, the authors suggested, hindered

their opportunities to engage in physical activity (Galdas et al., 2012). For middle-aged Indian migrant women living in Sydney, sport was a vehicle to develop friendships, particularly with women from diverse cultures. While there was some mention of social issues as potential influences on physical activity among older Indian migrants in the US and first-generation-middle-aged Indian migrant women in Sydney (Kalavar et al., 2005; Sawrikar & Muir, 2010), their perceived lack of social interaction was not explored. South Asians in Australia perceived the social aspect to be more in favour of physical activity practices in shopping malls (rather than outdoors) (Gupta et al., 2017). The impact of social factors on physical activity and sedentary behaviour among Indian migrants, and the underlying reasons for such impacts, are under-researched.

Most studies in the UK have pointed to multilevel factors, from motivations, attitudes, and barriers of culture, to school-based facilities, the neighbourhood, and parental cost-related concerns, all of which may influence intergenerational health behaviours (Bhatnagar et al., 2015). In Victoria, Australia, a qualitative study revealed some intergenerational patterns of physical activity contextualised to perceived cultural beliefs about physical activity among South Asians (Gupta et al., 2017). Participants retrospectively pointed to earlier generations having greater physical activity practices from accumulated and occupational activities, while middle-aged individuals exhibited lower physical activity levels, often driven by economic constraints that limited their ability to participate in physical activity (Gupta et al., 2017). However, the study did not account for the underlying reasons for the differences in physical activity participation between connected generations of migrants, which warrants more evidence specific to Indian migrants, particularly in Australia.

Factors related to the migration context

A cross-sectional study by Jonnalagadda and Diwan (2005) found a positive correlation between time spent in the host country and physical activity, suggesting that the frequency of participating in these activities increased with a greater number of years spent in the US. Both length of residence and ethnic identity were proxy measures of acculturation. In contrast, a study on South Asians in New Zealand found negative correlations between length of residence and physical activity, suggesting that activity levels decreased with greater time spent in New Zealand (Kolt et al., 2007). These inconsistencies may be attributed to the differing lengths of residence between the two samples— the average length of residence was 51 months in New Zealand, compared to the average length of residence of 25 years in the US. Additionally, the sample in the New Zealand study was heterogenous.

Limited research has examined the influence of ethnicity on physical activity. In the US, a bicultural and more American identity was positively associated with increased frequency of physical activity practices among middle-aged and older Indian migrant populations (Jonnalagadda & Diwan, 2005). A cross-sectional study in Guadeloupe also considered the role of ethnicity in physical activity among Indian migrants, finding that ethnicity significantly contributed to their low physical activity levels (Sinnapah et al., 2009). The study inferred that low energy expenditure observed among Indian migrants stemmed from their culturally inherited lifestyles, which differed from migrants in host countries (Sinnapah et al., 2009).

Qualitative studies conducted in the US, Canada and Australia revealed the influence of migration on physical activity among Indian communities, with factors related to low social networks, increased car usage, mechanised practices, and lack of time due to having new jobs (Galdas et al., 2012; Gupta et al., 2017; Kalavar et al., 2005; Mohan et al., 2008). Semi-structured in-depth interviews with family members of Indian migrants with cardiovascular diseases revealed that, upon migrating to Sydney, Australia, there was an increase in using cars as opposed to walking behaviour, which resulted in more time being sedentary (Mohan et al., 2008). Qualitative interviews that explored past experiences of older Indian migrants in the US noted that, in their country of origin, everyday physical activity behaviour was 'automated' in practices that required physical effort to perform daily functional tasks, such as manual cooking, cleaning, lifting, sweeping and walking as transport (Kalavar et al., 2005). Upon migration, these participants perceived that, in the host countries, less physical effort was needed to perform daily tasks, as a result of mechanised living, involving the use of vacuums, cars and washing machines (Kalavar et al., 2005). Consequently, Kalavar et al. (2005) suggested that individuals may grow more conscious about time spent on their physical behaviours, and ultimately opt for 'exercise' or planned sport and recreational practices. Little is known about how physical activity behaviours change among younger Indian migrants or second-generation individuals who are born in high-income countries or have migrated at a young age.

Psychosocial influences on physical activity behaviour

In the US and Canada, unfamiliarity with exercise and exercise settings (such as gyms and clubs) was perceived as a barrier for Indian migrants (Galdas et al., 2012; Kalavar et al., 2005). In Canada, Punjabi migrants perceived informal exercise such as outdoor walking motivated their physical activity compared to the unfamiliarity with the settings of a gym or community fitness centre (Galdas et al., 2012). Among Indian migrant women in Sydney, Australia, their perceived lack of skills in Australian sports ('footy' – Australian rules football) resulted in their low self-confidence about partaking in sports and recreational activities (Sawrikar & Muir, 2010). The lack

of motivation was expressed by other South Asians in Australia but underlying reasons were not explored (Gupta et al., 2017). Older Indian migrants in the US with no experience with planned exercise perceived this as a barrier to engaging in deliberate exercise behaviours (Kalavar et al., 2005). Their perceived self-motivation was important for engaging in physical activity in the host country (Kalavar et al., 2005). The impact of self-motivation on the physical activity behaviours of younger Indian migrants (<66 years) remains unknown.

Qualitative insights among South Asians (Indian and Sri Lankans) in Victoria, Australia, revealed that physical activity was perceived as an array of active behaviours, contrasting with the narrowed concept of 'exercise' held by Anglo-Australians (Gupta et al., 2017). Rooted in collectivist traditions, their traditional social norms for engaging in physical activity differed from Anglo-Australians (Gupta et al., 2017). They perceived that westernised individualist cultures inherently valued 'personal' needs, which motivated participation in the planned 'exercise' behaviour typical of Australians. The study's heterogeneous sample warrants further culturally targeted research to determine if these findings apply to Indian migrants in Australia.

Health and health communication

Health status: A qualitative exploration of physical activity barriers among sedentary older Indian migrants in the US revealed that poor health conditions, such as lower back pain and low blood pressure, instilled a fear of injury that prevented engagement in physical activity (Kalavar et al., 2005). In Canada, determining safe levels of exertion and fatigue (feeling weak) challenged Indian Punjabi men and women to engage in physical activity (Galdas et al., 2012). These barriers may be specific to the sample inclusive of patients with myocardial infarction participating in a recovery physical activity program (Galdas et al., 2012) and cannot be extrapolated to the general population.

Very little literature addresses the question of psychological distress among Indian migrant communities. Psychological stress, which is higher among South Asian migrants, lowers the probability of engaging in physical activity (Williams et al., 2011). As mentioned earlier, psychological stress was perceived as a barrier among Indian migrants in Sydney, Australia. However, further research is needed to explore psychological status and its impact on Indian migrants' physical activity and sedentary behaviour.

Traditional health beliefs and practices: Qualitative insights revealed that older Indian migrants regarded health as holistic and multifactorial including improved digestion, sleep, peace of mind, joint stiffness, and fitness (Kalavar et al., 2005). They perceived Indian traditional practices such

as yoga and pranayama not only encompassed physical and mental well-being but also cultural aspects in pursuit of good health practice (Kalavar et al., 2005). The authors Kalavar et al., (2005) referred to one participant who noted that the need to be "health conscious" was not inherent within the Indian health belief system, and reported this as a barrier to engaging in physical activity practices (p. 59). However, the reasons for not engaging in traditional practices such as yoga were unknown, and the possibility of exploring potential generational differences in these views presents an area for future research.

Health communication: The advice received from health professionals, mainly physicians/general practitioners, was often perceived by Indian migrants as a source of motivation to engage in physical activity behaviours (Gupta et al., 2017; Kalavar et al., 2005). Semi-structured in-depth interviews with South Asian migrants revealed that health advice should not only be focused on physical and mental benefits but should also consider cultural and individual aspects as equally important (Gupta et al., 2017). South Asian migrants perceived health benefits linked to physical activity such as a lower rate of illness, which motivated their need to engage in physical activity (Gupta et al., 2017).

South Asians in Victoria discussed the role of Australia's media messaging of health benefits of physical activity behaviours as potential facilitators, not only for Anglo-Australians but also for South Asian participants (Gupta et al., 2017). Focus group interviews with Indian migrant women in Sydney, Australia, revealed that they perceived a lack of ethnic representation in Australia's sport promotion campaigns (Sawrikar & Muir, 2010). Whether or not media messaging is a facilitator or barrier for physical activity in Australia specific to men and women in this population is yet to be determined.

Physical environment and influences on physical activity

There is little insight into the physical environment on physical activity behaviours specific to Indian migrants globally. Based on qualitative insights of South Asians and Anglo-Australians in Victoria, neighbourhoods and parks were perceived to be more beneficial for physical activity practices (Gupta et al., 2017). However, these locations were used more for walking practices among Anglo-Australians. The underlying reasons why South Asian migrants did not use similar locations for walking behaviours were not explored. Outdoor weather emerged as a distinct barrier to physical activity among these South Asian migrants, who perceived shopping malls had steady temperatures more conducive to their physical activity practices (Gupta et al., 2017). Older Indian migrants in the US perceived speeding cars and inadequate sidewalks as barriers to participation in physical activity (Kalavar et al., 2005). Cold and snow were also perceived barriers

for older Indian migrants in the US (Kalavar et al., 2005). In research conducted in Guadeloupe, the authors hypothesised that Indian migrants' chosen geographical location overlapped with other sociocultural factors, such as social mannerisms and culturally inherited behaviours, which may have influenced the low physical activity levels, and the authors suggested more research that considered these variables is needed in Indian migrant communities (Sinnapah et al., 2009). The study only considered factory workers attending their annual check-ups from one medical centre. Using a non-representative sample sets limits on the generalisability of such findings.

Social and material resources and opportunities in life

There is little understanding of the role social resources have in promoting Indian migrant physical activity, particularly in the context of opportunity (i.e., access to facilities and relevant initiatives). Indian migrant women in Sydney revealed a sense of belonging to Australian sporting practices was essential to assimilate within the Australian sporting environment, and because of this they expressed neither a lack of interest in partaking in physical activity nor a lack of readiness to do so (Sawrikar & Muir, 2010). However, the demographic survey revealed six of seven Indian women had not participated in any sporting activities (Sawrikar & Muir, 2010). Such contrasts in findings led the authors to infer that while equality may explicitly prevail in Australia's sporting culture, the ground for opportunity (equity) in practice may not be seen by certain migrant communities, such as these Indian migrant women (Sawrikar & Muir, 2010). This suggests a perceived sense of social exclusion may compound their perceived lack of ability in the context of undertaking new physical activity and sporting pursuits in Australian settings (Sawrikar & Muir, 2010). The authors inferred that the perceived lack of ethnic representation in Australian organisational policies and sporting teams had compounded their racial experiences in Australia (Sawrikar & Muir, 2010).

Summary

Most evidence regarding influences on physical activity among Indian migrants is qualitative, with no studies focused on influences on sedentary behaviour in this group. Data on Australian samples are limited. Further, considering a range of contextual influences highlighted in the work of Holdsworth et al. (2017), several of these contextual factors remain under-researched for Indian migrant physical activity (e.g., physical environment, opportunity, occupational/institutional factors, social factors, discrimination).

Globally, the sample population chosen had varying characteristics across the qualitative studies in the different countries. For instance, in the US, qualitative insights were mainly derived from

older Indian migrants. In Canada, participants mainly included patients with cardiovascular diseases (Galdas et al., 2012). In Australian studies, the samples were either heterogeneous (Indians and Sri Lankans) (Gupta et al., 2017) or only composed of Indian women (Sawrikar & Muir, 2010). More research is needed to understand what contextual factors in high-income countries facilitate their engagement and adherence to physical activity and sedentary behaviour. Quantitative insights into influences on physical activity and sedentary practices from studies focusing on Indian migrants are mainly contextualised to socio-demographic variables based on US Indian migrants. Very little is known about intergenerational patterns of physical activity and sedentary behaviour in Indian migrant communities worldwide and in Australia.

2.4. Measures of physical activity and sedentary behaviour

Impetus for good measurement

Good measures are required for assessing a population's physical activity and sedentary behaviour, and estimating their adherence to recommended guidelines. To date, there is no single preferred device or method existed to assess the diverse modes of physical activity (Seefeldt et al., 2002). Many devices and methods have been developed to measure physical activity such as direct and indirect calorimetry, surveys, observation, motion sensors and mechanical electronic monitors that count steps (Ndahimana & Kim, 2017; Sallis, 2009). Challenges in measuring physical activity and sedentary behaviour stem from the variations in methodological approaches and measurement tools that differ in their validity, reliability, cost and intended use (Seefeldt et al., 2002).

Selecting appropriate methods becomes more complex with a variety of physical activity behaviours borne from individual preferences, within cultures and across cultures (Kriska, 2000; Seefeldt et al., 2002). When assessing individuals' patterns of physical activity and sedentary behaviour, it is important that measurement methods are suited to the population/culture while being cost-effective and user-friendly (Ceria-Ulep et al., 2011; Kriska, 2000; Seefeldt et al., 2002).

Self-report and objective-device-based measures

Self-reports such as questionnaires, logs and diaries are often used to measure physical activity (Bauman et al., 2009). These measures are preferred for their feasibility, cost-effectiveness and ability to pick up the type of activity, and for obtaining quick information, particularly within large population groups (Prince et al., 2008). However, self-reports have inherent limitations, namely recall of responses, potential for the poor understanding of questions (comprehensibility),

bluntness due to selection of responses from alternatives (e.g., Likert scales), and the risk of information mistranslation by the researcher or a trained professional (Sallis & Saelens, 2000).

Recently, device-based measures, for example, accelerometers, and pedometers, have been used to assess physical activity and sedentary behaviour across different countries and cultures (Hagströmer et al., 2010; Kapteyn et al., 2018). Contrary to self-reports, device-based measures do not rely on recall and other associated biases and provide a more accurate and precise estimate when measuring a variable of interest (e.g., total step counts) (Pedišić & Bauman, 2015; Prince et al., 2008). However, such measures also have inherent limitations. For example, motion sensing devices such as accelerometers are limited in their ability to measure non-ambulatory activities (cycling) over ambulatory activities when worn on the hip or waist position (Pedišić & Bauman, 2015). These measures are reliant on people fitting the device correctly, dependent on the type of activity, and required amount of wear time. They are costly and more labour intensive than questionnaires, particularly for population studies (Matthews et al., 2012; Pedišić & Bauman, 2015).

Self-reports allow information on the context and type of physical activity and sedentary behaviour to be determined (Ju et al., 2011). Hence, researchers need to be cognisant of the fact that objective/wearable-device measures are different from self-reports, and cannot replace the value of understanding the context in which the physical activity and sedentary behaviour occur (Troiano et al., 2012), which is better captured with self-report questionnaires (Atkin et al., 2012; Hills et al., 2014).

Positioning self-report and objective measures for use among Indian populations

Assessing physical activity and sedentary behaviour mainly with self-report measures is greatly dependent on the culture or the population characteristics (Wanner et al., 2016). Different practices and perceptions of physical activity may exist among different individuals and different cultural populations that vary according to cultural, socio-economic, and geographical circumstances (Bradburn & Miles, 1979; Kapteyn et al., 2018). Differences may also occur in the way the same type of activity is practised by the same ethnic group from different geographical-regional origins (Kriska, 1997), such as north, south, east and west regions of India.

Most self-report questionnaires consider activities that are common in high-income countries; culturally specific activities practised within culturally and linguistically diverse groups are generally not captured and remain under-researched in the physical activity literature (Shephard, 2003). Such measurement inadequacies provoke questions about the cultural appropriateness

of the psychometric properties of current physical activity self-report measures in the research conducted on non-Western populations (Booth, 2000). Thus, there are not only inherent but also cultural limitations that can minimise the reliability and validity of measuring physical activity behaviours, particularly with self-reports (Shephard, 2003).

Physical activity measurement instruments

Few questionnaires used among Indian populations mainly in India, their country of origin, have considered cultural relevance (as opposed to Indian migrant populations globally – see Table 2, below). In India, the recently developed Madras Physical Activity Questionnaire (MPAQ) considered state-wide population characteristics when assessing domain-specific physical activity and sedentary behaviour (Anjana et al., 2015). The MPAQ also considers the household domain separately from other physical activity domains (as opposed to GPAQ where household and occupation are merged as one domain). Previously, the physical activity questionnaire (PAQ) (Bharathi et al., 2000), developed solely for epidemiological use, was modified for the Indian Migration Study (IMS-PAQ) when assessing physical activity and sedentary behaviour among rural and urban residents from different regions in India (Sullivan et al., 2012; Sullivan et al., 2011). Both the IMS-PAQ and the MPAQ have good reliability and validity (Intraclass Correlation Coefficient ICC = 0.84 and 0.82 respectively) for assessing physical activity and sedentary behaviour contextualised to India (Anjana et al., 2015; Sullivan et al., 2012).

Contrary to instruments developed in India, the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003) was developed by a global consensus group in 1998, with the long version (which includes all domains assessed with 27 questions) recommended for population studies over the shorter version (Hagströmer et al., 2006; Kim et al., 2013). The Global Physical Activity Questionnaire (GPAQ) (Bull et al., 2009), which consists of 16 questions, was also developed by the World Health Organization, and used in a stepwise approach to initiate uniformity in data collection and for making comparisons among populations from low-to-middle-income countries (Bull et al., 2009). Both questionnaires were developed to assess and monitor physical activity in low-to-middle-income and included the physical inactivity risk factor in national surveillance systems, which enabled the comparison of adult participants from 122 countries (Bull et al., 2009; Craig et al., 2003). The GPAQ is considered reliable and valid for the Indian population in their country of origin, as the questionnaire has the ability to accommodate cultural variations (Armstrong & Bull, 2006), whereas the validity and reliability of IPAQ are yet to be accepted for Indian migrant populations (Craig et al., 2003). The use of the GPAQ and IPAQ-Long version (as opposed to the IPAQ-Short version) is encouraged in population-based studies as they independently assess total and context-specific physical activity in domains of

occupational, active travel, leisure-related and sitting behaviour (Hagströmer et al., 2006; Kim et al., 2013).

Table 2 *Self-Report Instruments Used to Measure Indian Physical Activity and Sedentary Behaviour*

Instrument	Instrument Features	Domain PA/SB	Indian Population	Reliability/Validity
IMS-PAQ	30 days No seasonality of occupations and variations in PA Country-specific sports & household chores Rural/Urban	Adapted the PAQ to suit rural and urban settings; four industry-based populations within regions	Appropriate for PA of individuals in India; may need refinement for sedentary population and women in India	Reliability: good ICC= 0.84; Validity referenced accelerometer 4 days:
Madras Diabetes Research Foundation- PA Questionnaire (MPAQ)	Av. day, week, month: 1 year = daily avg. summed up for 24 hr. period Habitual & culturally relevant PA Multiple activity domains: Seasonal, non-seasonal activities Rural /Urban 10 states	Four domains: Occupational; Transport; Recreational; Daily living	Culturally adapted for Indians across various regions	Reliability: ICC=0.82, good reliability 30 days. Moderate validity reference - GPAQ ICC = 0.40
PAQ	4 wk. recall; 24hr energy expenditure, occupation & discretionary leisure	-Sports, games; -hobbies/ manual labour, -sedentary: reading, TV; -discretionary activities: socialising, active travel -sleep hrs/day	Administered in urban middle-class India; not for evaluation of individual patterns of PA, only for epidemiological use and insight into PA behaviour	No accounting for reliability, validity
GPAQ	Assess weekly PA	PA domains: work, transport (only walking cycling), leisure, sedentary 1 item question: sitting time	Other developing nations; not regionally/culturally specific	Reliable & valid for low-to-middle-income countries; concurrent validity with IPAQ
IPAQ	Assess weekly PA	Occupation, transport (only walking cycling), leisure, sedentary 1 item question: sitting time	Other developing nations; not regionally/culturally specific	Reliable & valid for low-to-middle-income + high-income countries (not Indians); validated (accelerometer)

Evidence suggests a composite measure is needed in assessing sedentary behaviour (Prince et al., 2018), particularly in a population whose sedentary practices may vary from day to day (Prince et al., 2018). Such variations may be less well captured by single-item self-report questionnaires such as GPAQ and IPAQ that mainly focus on physical activity. The use of multi-item instruments has been encouraged for greater depth in the understanding of sedentary patterns among such populations (Prince et al., 2018). Challenges may stem from existing multi-item instruments whose validity and reliability are not contextualised to an Indian population.

In 2018, the Asian Sedentary Behaviour Questionnaire (ASBQ) was developed to assess domain-specific and total sedentary behaviour in adult Asian populations of Indians, Malays and Chinese (Chu et al., 2018). The questionnaire drew components from the Sedentary Behaviour Questionnaire (SBQ) (Rosenberg et al., 2010), Sitting Questionnaire (Lynch et al., 2014), Week-long Sitting Behaviour Questionnaire (Wijndaele et al., 2014), and Workforce Sitting Questionnaire (Chau et al., 2011). It estimated sedentary time, such as time spent sitting, in a typical week in the different domains of work, household, transportation (vehicle sitting), and leisure-time sedentary domain (e.g., eating meals, use of televisions, socialising, and playing cards). This domain-specific seven-item questionnaire has moderate to good reliability (Spearman's rho: 0.53-0.64) in estimating the Asian population's sedentary time when either self- or interviewer-administered (Chu et al., 2018).

2.5. Using models or frameworks to understand influences on physical activity and sedentary behaviour

Physical activity and sedentary behaviour are influenced by multiple factors extending beyond the individual alone (O'Donoghue et al., 2016; World Health Organization, 2018a). Such factors are either *fixed*, for example, genotype, age, gender, or ethnicity; or *modifiable*, for example, personal traits, support systems, occupation, community and environmental circumstances (Seefeldt et al., 2002). The *Global Action Plan on Physical Activity* (World Health Organization, 2018a) emphasised the need for positioning a comprehensive multi-factorial viewpoint for increasing or re-establishing everyday lifestyle behaviours. A multi-factorial perspective to understanding health behaviours was considered vital for equitable and ecologically well-balanced ways of living (Foster et al., 2018; World Health Organization, 2018a).

There is a lack of theoretical grounding in most physical activity studies involving culturally and linguistically diverse communities, particularly migrant populations (O'Driscoll et al., 2014). O'Driscoll et al. (2014) argued that literature not grounded in theory engenders limits when understanding contextual information and influences on physical activity and sedentary

behaviour which, in the context of migrants, must be understood given the health-related risk. Hence, multilevel frameworks are needed in migrant physical activity research, as they act as guiding tools in understanding the extent and direction of how the various psychosocial-environmental, sociocultural, and economic factors interact with and mediate physical activity and sedentary behaviour (Brug & Chinapaw, 2015).

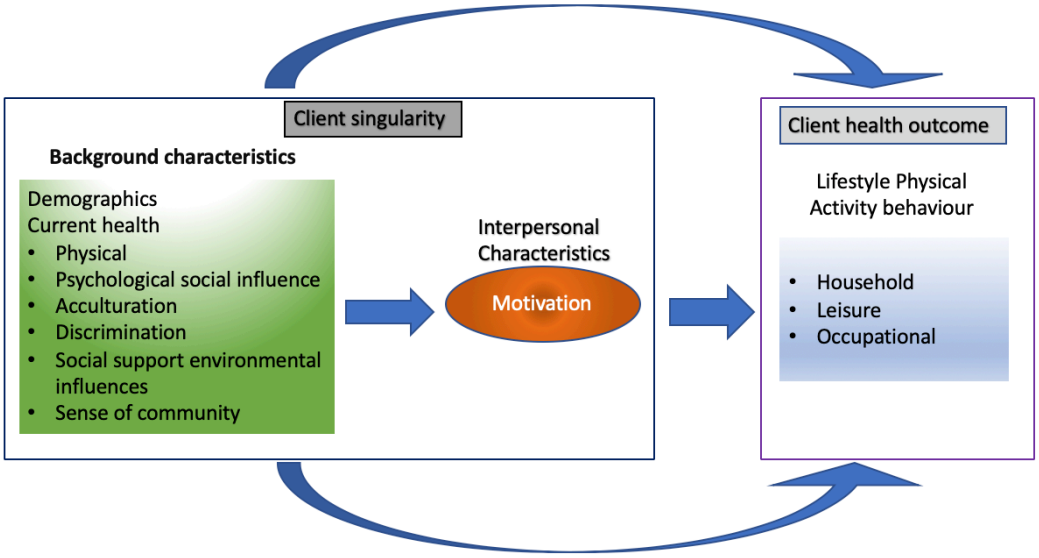
General models of physical activity

Generally, in the context of sport and physical activity, the socio-ecological model is most commonly adopted as the theoretical platform (Cerin & Leslie, 2008; Sallis et al., 1998; Sallis et al., 2015). Similar concepts are used in Wetter's model (Wetter et al., 2001) to specifically explore the potential influences and determinants of lifestyle physical activity behaviours. Wetter's (2001) model was used to identify the correlates of physical activity among Indian migrants in the US (Jonnalagadda & Diwan, 2005).

Existing models for migrant populations

Daniel and Wilbur (2011) adapted Cox et al.'s (2008) interaction model of client behaviour to conceptualise a framework to guide the process of reviewing evidence on physical activity among Indian migrants (among other South Asian migrants). As shown in Figure 4, below, the original model was based on the nursing theoretical framework, which conceptualised fixed (static) and modifiable (dynamic) factors as potential influences on health behaviour change (Cox et al., 2008). The model enabled the selection of various 'individual'-level factors such as demographics (e.g., age, current health status) or sociocultural factors (e.g., acculturation, social influence) which remain static over time. The dynamic-intrapersonal variable of motivation was considered to be more responsive to change when influencing the occupational, leisure and household physical activity behaviours of Indian migrant communities (Daniel & Wilbur, 2011). Motivation was proximal to the proposed framework (Daniel & Wilbur, 2011). The framework has been used to guide research on physical activity mainly amongst women from African American and European-Caucasian communities (Wilbur et al., 2003) and to identify correlates of physical activity among Korean migrant women (Choi et al., 2008).

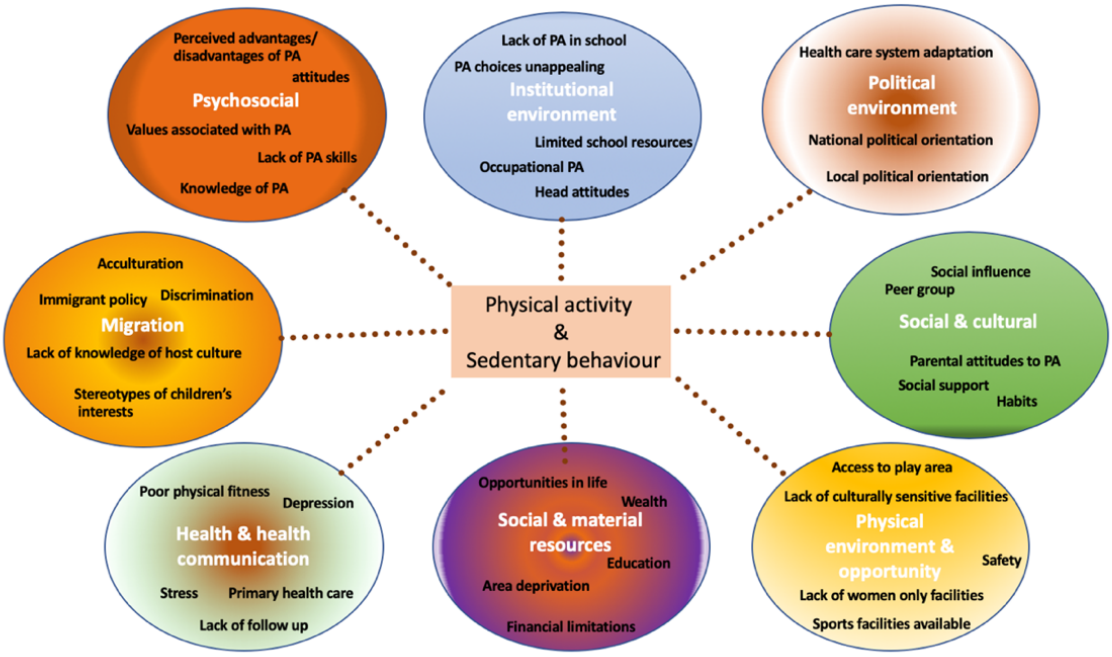
Figure 4 *A Physical Activity Framework for Indian Migrants*



Note. This framework was proposed in a review published by Daniel and Wilbur (2011).

More recently, in 2017, a systems-based framework was proposed for identifying influences and understanding relevant contexts of physical activity behaviours among ethnic minority migrant groups in Europe (Holdsworth et al., 2017). A concept mapping approach, involving international professional experts, was used to develop the framework and eight clusters (from 183 factors) that related to ethnic migrant physical activity were identified. Each cluster is a component of cultural adaptation in the context of behaviour change and influences on ethnic migrant physical activity and sedentary behaviour (see Figure 5, below).

Figure 5 *Systems-Based Framework for Ethnic Minority Populations*



Note. The dotted lines show factors in the cluster linked with behaviours, but they do not indicate evidence for causation. This figure is reproduced from Holdsworth et al. (2017).

Based on the concept mapping, the social-cultural environment (53 factors) emerged as the fourth most important cluster, followed by the psychosocial cluster (38 factors), with the least important being the political-environment cluster (three factors) (Holdsworth et al., 2017). In the study by Holdsworth et al. (2017), ethnic migrants in Europe ranked the sociocultural as the most important cluster, followed by migration, social material and psychosocial clusters as priority influences on their physical activity behaviours. Contrary to the general populations in Europe, ethnic communities in Europe ranked the physical environment and institutional environment as priority clusters for physical activity and sedentary behaviour respectively, with the political environment as the third most important influence while, for the general population, it was ranked fifth for physical activity and sixth for sedentary behaviour (Holdsworth et al., 2017). Each of the eight clusters provides an opportunity for contextual insights relative to the migrant population or enables new insights to emerge towards informing ecological equity involving multicultural/diverse populations. A systems-based mindset may be better able to guide future interventions than focusing on individual behaviour alone, which remains insufficient, in an attempt at behaviour change (Rutter et al., 2017). This systems-based framework is a conscious attempt to inform the research process and, subsequently, provide a context for the optimal direction of interventions (Holdsworth et al., 2017).

2.6. Summary of the literature review

The findings from this review consistently show that Indian migrants have insufficient levels of physical activity and are inclined towards sedentary behaviour. The evidence predominantly relies on self-reported measures which lack cultural specificity and are weak in regard to capturing the types and contexts of these behaviours, creating gaps that challenge the contextual understanding of these behaviours among Indian migrants globally. Sedentary behaviour in this population is under-researched, with few studies assessing physical activity and sedentary behaviour beyond a single domain to include those activities and behaviours specific to the practices of Indian migrant populations. Additionally, how intergenerational factors may impact Indian migrants is unknown in Australia and under-researched globally.

For a comprehensive understanding, there is a need for cultural depth in the exploration of beliefs, attitudes, and behaviours in physical activity research (Brown et al., 2015) within Indian migrant communities. Physical activity interventions aimed at preventing health risk behaviours among South Asians (Admiraal et al., 2013; Bhopal et al., 2014; Brown et al., 2015; Ramachandran et al., 2006; Wallia et al., 2013) have shown small to moderate effects, primarily due to the lack of culturally targeted approaches that address the community's specific needs (Muilwijk et al., 2018). While qualitative approaches may establish 'cultural depth' (Pearce, 2009), both qualitative and quantitative insights are needed (Brown et al., 2015).

Given the developing sedentary behaviour patterns and low physical activity levels among Indian migrants, perpetuated by their genetic predisposition to an NCD risk burden, a better understanding of their physical activity and sedentary behaviour is essential. The evidence emphasises that "Appropriate strategies for physical activity can only be developed if research results are presented separately for each ethnic group" (Bhatnagar et al., 2015, p. 17). Considering the heterogeneity of the Indian culture, a culturally focused approach is essential for exploring such population-specific lifestyle behaviours as those of migrants. The key influences on physical activity and sedentary behaviour must be examined to inform the development of strategies to improve physical activity and, ultimately, improve health outcomes in this growing at-risk group. Additionally, considering physical activity and sedentary behaviour among first- and second-generation migrant populations could benefit the future health-risk-related lifestyle behaviours of Indian populations in Australia.

Therefore, the central question addressed in this thesis is: How do key contextual factors relate to experiences of physical activity among Indian migrants living in Australia? The supporting aims are to critically explore and measure key contextual factors (e.g., sociocultural) associated with

the patterns of sport and physical activity among Indian migrants living in Australia, and to triangulate evidence-based insights to inform and tailor policy recommendations that promote equitable access and opportunities for migrant participation in and through sport and physical activity. The diverse contextual domains presented by Holdsworth et al. (2017) serve as the overarching theoretical framework for this thesis.

CHAPTER 3. PHILOSOPHICAL UNDERPINNINGS OF MIXED-METHODS RESEARCH

3.1. Introduction

Chapter 2 presented the literature review of empirical qualitative and quantitative research studies. The present chapter outlines the fundamental components of the research approach: philosophical assumptions, methodology, and research design. It explains how these components support conducting mixed-methods research as the methodological approach (Creswell & Clark, 2017), justifying this approach as a planned course of action (Crotty, 1998) to address the overarching research question: How do key contextual factors relate to experiences of physical activity and sedentary behaviour among Indian migrants living in Australia? Specifically, this involves a parallel and a sequential component constituting qualitative and quantitative phases (Creswell & Clark, 2017) across studies one to three of the multistage research framework (Fetters et al., 2013) presented in section 1.5, Figure 1. Chapters 4 - 5, as published papers, specify the methods and procedures used in the qualitative studies, Chapter 7 covers the quantitative study, and Chapter 8 describes the methodological details of the concluding policy study, Study Four.

3.2. Research paradigms: Philosophical assumptions

The research methodological approach is typically influenced by the philosophical assumptions inherent in a paradigm. A paradigm is a matrix of beliefs and perceptions derived from interactions with the social world (McNamara, 1979). Characteristic of a paradigm is an exploration of the nature of reality (ontology), and what consists of knowledge and who can possess it (epistemology) (Crotty, 1998; Guba & Lincoln, 1994). Such ontological and epistemological positions shape the thinking or approaches of the methodology, and the methods employed. However, a paradigmatic shift is likely on account of the knowledge and position of reality within a given cultural context. To the scientific community, the most acceptable methodology and methods are those that best uncover the ontological and epistemological positions of the paradigm in which the research study is situated (Denzin & Lincoln, 2000, 2013). In this chapter, I explore how the pragmatist paradigm supports understanding the meaning and experiences of physical activity and sedentary behaviour among Indian populations within their given cultural context.

The Indian philosophical lens

In the Indian conception of the world (worldview), knowledge and reality (epistemology, ontology) are close-fitted positions. The foundation of what is knowledge and who can know it lends itself to an intrinsic rather than an extrinsic exploration (Bhawuk, 2010). The Indian worldview upholds one central idea of one world which comprises different yet unified elements referred to as Brahman. There is a strong emphasis on spirituality and the human experience in the Indian worldview. These are not treated as separate but integrated as elements of the Brahman or universe. The Brahman (universe) is seen to work in harmony and supports ideas of integration of the spirit and the material which is often considered the key to existence. Such ideas have been positioned by the ancient scriptures such as the Vedas and Upanishads that form the basis of Indian philosophy, particularly within Hinduist traditions. Hence, in the Indian worldview, there exist *multiple lines of thinking,* and truth is the *balancing*, and *not the separation*, of dualities and trichotomies (Bhawuk, 2010; Ghosh, 2019). In practice, therefore, social interactions and occupational settings provide an epistemological gateway to understanding Indian thoughts, feelings, beliefs and emotions (Bhawuk, 2010). Considering the complex and integrated nature of Indian worldviews, methodological approaches that support the bringing together of diverse experiences from (multilevel frames) beyond the physical but also spiritual and social have been encouraged (Bhawuk, 2010; Ghosh, 2019). Scientific methodologies that solely rely on Western philosophy may produce evidence that is challenging to translate or apply to health-related initiatives for Indian and other populations (Dickerson et al., 2020). Therefore, selecting methodologies that align with the Indian philosophical lens could allow for a deeper exploration of perspectives, behaviours and practices on topics and issues such as physical activity and sedentary behaviour. In this chapter, I outline how the pragmatist paradigm helps 'bring together' a comprehensive and unified understanding of the meaning *and* experience of physical activity and sedentary behaviour among Indian migrants.

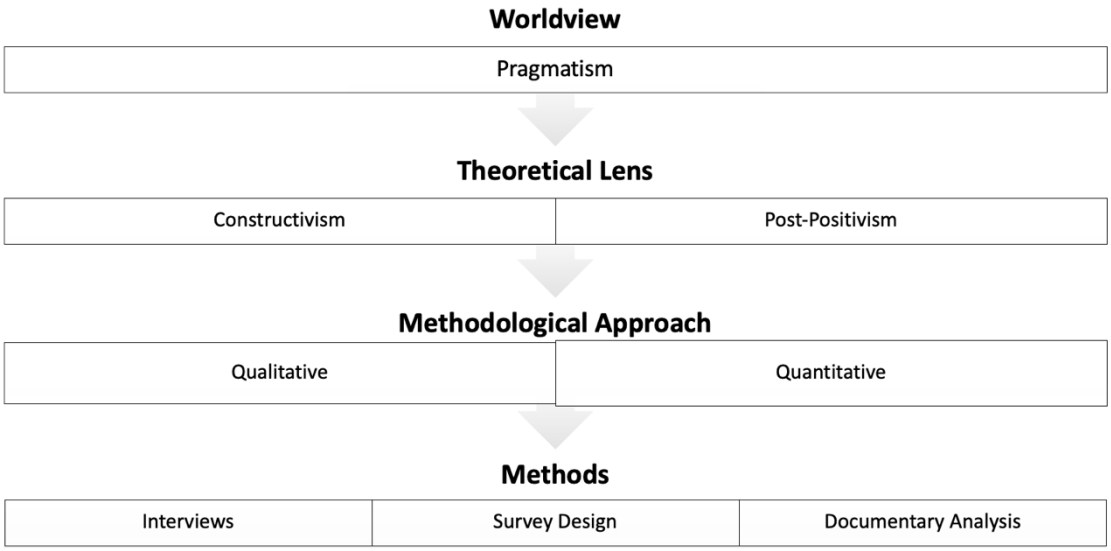
Pragmatism

Traditional, qualitative or quantitative paradigms perpetuate the worldview that an individual's experience *either* stems from one universal truth (quantitative paradigm) or multiple truths/realities (qualitative paradigm) (Johnson et al., 2007). However, in this study, I adopt the pragmatist paradigm which takes a middle ground between such purist contentions, recognising that knowledge stems from *multiple* perspectives, theories or paradigms (Johnson et al., 2007). Pragmatism supports the *dialectic* position, adopting separate paradigms for both qualitative and quantitative approaches (Greene & Caracelli, 1997; Onwuegbuzie & Leech, 2005). This approach resonates with the integrated perspective of the Indian worldview, acknowledging that knowledge, meaning, and value emerge from the consequences of diverse actions and

experiences. By embracing both qualitative and quantitative approaches, the pragmatic lens enables a comprehensive understanding of the diverse perspectives and behaviours of Indian migrants regarding physical activity and sedentary behaviour (Feilzer, 2010; Greene et al., 1989; Teddlie & Tashakkori, 2009).

As illustrated in Figure 6, below, in this thesis, constructivism informs the qualitative phase and post-positivism is associated with the quantitative phase (Creswell & Clark, 2017). The qualitative constructivist stance is rooted in the subjective experiences of Indian populations, which means it helps in exploring and understanding their perceptions and behaviours, past or present, related to physical activity and sedentary behaviour. The quantitative post-positivist stance enables the research team to isolate and narrow down key variables derived from the insights drawn from these subjective experiences, and to draw hypotheses about their relationships with physical activity and sedentary behaviour (Creswell & Clark, 2017). The team can make detailed observations and measure these key variables to better understand the key factors that influence such behaviours among Indian migrants. By *integrating* elements of constructivism and post-positivism, the thesis highlights the research team's overarching pragmatic philosophical stance of aiming *to explore and identify* the contextual influences on physical activity and sedentary behaviour and quantitatively *measure the associations* between the key contextual factors underpinning these behaviours among Indian migrants in Australia. This approach embodies what Guba and Lincoln (2005) described as “the best of both worldviews” (p. 201). This flexibility offered by the pragmatic lens is most fitted to mixed-methods research approaches (Feilzer, 2010; Johnson & Onwuegbuzie, 2004).

Figure 6 *Key Elements in Designing a Mixed Methods Research Study, Operationalising the Broad Philosophical Views to Specific Data Collection Techniques*



3.3. Methodology

A mixed-methods approach allows for the *deliberate integration* of both qualitative and quantitative approaches *within a single study* (Creswell & Clark, 2017) supporting an in-depth investigation of the nature of physical activity and sedentary behaviour among Indian migrants in Australia. Qualitative data offer rich contextual insight, while quantitative data offer a degree of statistical generalisability (Creswell & Clark, 2017). Employing both qualitative and quantitative designs not only accommodates the dialectical perspectives of Indian migrants, and the Indian philosophical lens mentioned above (Bhawuk, 2010; Ghosh, 2019) but also enables a more nuanced examination of their physical activity and sedentary behaviour, addressing gaps identified in the literature review in Chapter 2, such as the need for a culturally adapted survey measure. Leveraging the strengths of both methods better addresses the first supporting aim of this thesis: To critically explore and measure key contextual influences on the patterns of sport and physical activity among Indian migrants living in Australia. The flexibility of the mixed-methods approach affords a tailored strategy, wherein the individual sub-questions of each study along with contextual/cultural aspects, whether previously known or emergent during the research process, are integrated to address the overall research question. See Table 3, below.

Table 3 *Overview of the Research Sub-Questions, Study Design, and Brief Outline Supporting an Exploratory Design–Instrument Development Model*

Research Sub-Questions	Methodology Type	Study Design	Methods	Chapter
1) What is known about the levels of physical activity and sedentary behaviour of Indian populations when living in their country of origin and as migrants in high-income host countries? 2) What are the diverse contextual influences on physical activity and sedentary behaviour among Indian migrants?	Review of literature	Integrative review of literature (*Informs exploratory sequential methodology*)	Prisma, peer-reviewed qualitative and quantitative studies, and a brief outline of existing models/frameworks and measurement tools.	2
3) What are the perspectives on physical activity and sedentary behaviour, and what key contextual factors influence participation in physical activity and sedentary behaviour among Indian migrants residing in Australia?	Qualitative descriptive study	Exploratory sequential, Phase I (*informs instrument design stage*)	Semi-structured interviews, purposive sampling. Thematic inductive data analysis.	4, 5
4) What key constructs, scales and items represent the qualitative data?	Survey instrument – adaptation and validation (face)	Exploratory – Instrument design stage *(informs quantitative Phase II)*	Modified Delphi approach, purposive sampling, research and cultural experts. Rounds: Expert survey review, feedback session, cognitive interviews. Descriptive coding.	6
5) What is the association between sociocultural factors and overall sport and physical activity levels among Indian migrants living in Australia, pre- and post-migration?	Quantitative – cross-sectional study	Exploratory sequential, Phase II	Online cross-sectional survey, non-probability sampling. Multiple linear regressions.	7
6. What is the contextual landscape of sport and physical activity policies in	Policy document analysis	Parallel	Documentary analysis, Deductive content analysis.	8

Australia, and how do these policies address the inclusion of migrants and promote equitable access and opportunities for their participation in and through sport and physical activity in Australia?	

Note. The exploratory design–instrument development model was proposed by Creswell and Clark (2007, 2017). The final policy study was conducted in parallel under an overarching multistage mixed-method research framework introduced in Chapter 1 – see also Fetters et al. (2013).

Key procedural decisions considered in planning mixed-methods research

In undertaking this mixed methods design, various procedural decisions were made about the *timing or sequence* of data collected, the level of emphasis or *weighting* given to qualitative and quantitative phases, and at what point integration or *mixing* occurred. These decisions are summarised in Table 4, below. The dimensions addressed in these decisions specifically pertain to the first research aim, which was to critically explore and measure key contextual factors (e.g., sociocultural) associated with the patterns of sport and physical activity among Indian migrants living in Australia.

Both qualitative and quantitative studies were deemed essential to address the overall research question, How do key contextual factors relate to experiences of physical activity among Indian migrants living in Australia? Chapters 4 and 5 describe the qualitative study aimed at *exploring* the contextual influences, while Chapters 6 and 7 provide details aimed at *measuring* these key contextual influences of physical activity and sedentary behaviour.

The sequential component of this thesis, integrates qualitative data and analysis to inform the data collection occurring in the quantitative study involving the refinement and cultural adaptation of a survey instrument, described in Chapter 6. The quantitative phase is informed by the qualitative data and analysis, and quantitative data and analysis later build on the qualitative data. The data from these interdependently staged qualitative and quantitative phases are *merged* at the interpretation and reporting levels, triangulating the overall findings as discussed in Chapter 9.

Table 4 *Summary of Key Considerations in Undertaking the Mixed-Methods Approach*

Key dimension	Description	As reflected in the thesis
Theoretical Drive-Pragmatism and Indian Cultural Lens	Equal priority for qualitative phase and quantitative methods	Both are equally important in being able "*to explore"* the contextual influences and "*to measure*" these key contextual influences.
Points of Integration	*Connecting* at the study design level	Qualitative data inform quantitative data collection approach – instrument adaptation (Chapter 6).
	Merging at the interpretation and reporting level	Integration through narratives using weaving for reporting themes across studies (Chapter 9).
Timing/Sequence	Sequential and dependent	Qualitative data are collected and interpreted first (Chapters 4 and 5) to

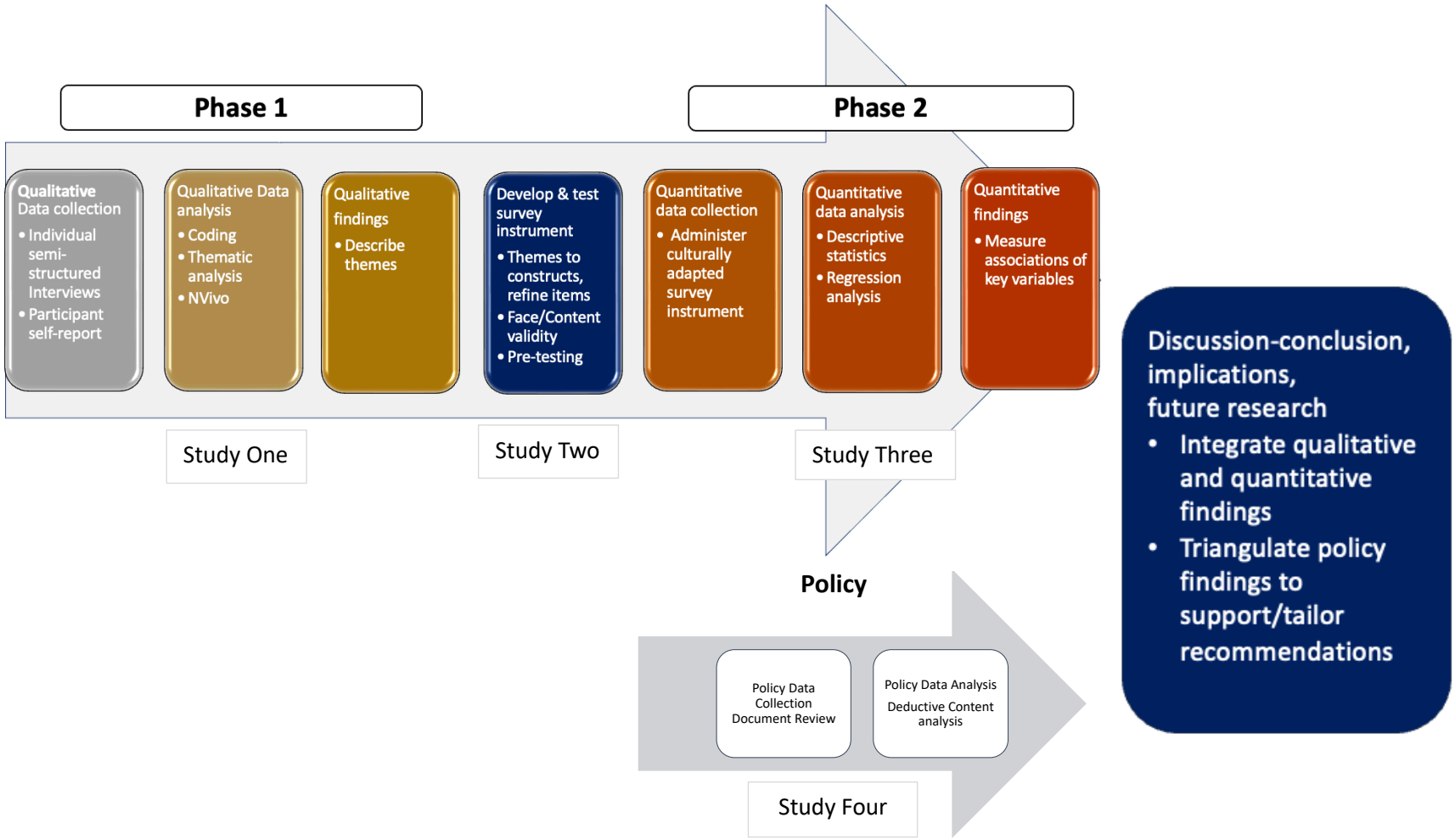
Note. These key considerations for a mixed-methods approach are drawn from those originally proposed by Creswell and Clark (2007) and also reflected by Fetters et al. (2013).

The findings taken into each stage supported the adaptation of a culturally appropriate survey instrument to measure key contextual factors influencing Indian migrants' physical activity participation experiences. In major exploratory mixed-methods designs, when adapting new research instruments, the specific design choice is typically considered an exploratory-design instrument-development model (Creswell & Clark, 2007; Creswell & Creswell, 2017). For clarity, this thesis refers to this mixed-methods research design as an exploratory sequential design.

3.4. Research design: Exploratory sequential design

The research reported in this thesis involved a two-phase exploratory sequential design (Creswell & Clark, 2017). The initial qualitative phase included conducting semi-structured interviews to gain a deep understanding of the meaning of physical activity and sedentary behaviour among Indian migrants, along with the contexts that influence participation in these behaviours. Themes and codes analysed from the semi-structured interviews helped to identify key constructs and the selection of existing scales and items that measure these constructs. The qualitative insights assisted the researchers in generating hypotheses about the key contextual factors influencing physical activity and sedentary behaviour, measured subsequently in the quantitative phase (Creswell & Clark, 2017). Here, the cultural context was crucial in comprehending the unique social and cultural factors underpinning the Indian philosophical lens influencing Indian migrant behaviours. Insights from the qualitative phase, such as the phrases from the qualitative interviews, helped in adapting survey items from the existing survey instruments not currently culturally tailored for Indian migrants. The subsequent quantitative phase measured the social and cultural contexts, providing empirical findings about associations that build on the qualitative insights into the relationships between these factors and overall physical activity participation among Indian migrants in Australia (Creswell & Clark, 2017).

Figure 7 *Two-Phase Exploratory Sequential Design and Parallel Policy Study*



Note. This figure shows the integration of the research design, with data analysis from the qualitative phase informing data collection in the quantitative phase, and merging data at the interpretation and reporting level – see also Fetters et al. (2013).

Bridging policy

As can be seen in Figure 7, this thesis concludes with bridging policy, to facilitate the translation of qualitative and quantitative research insights into informed policy recommendations. The integration of mixed-methods findings with policy considerations (Chapter 9) enabled a dynamic understanding of the issues, accounting for changes over time (pre- to post-migration) and supported tailored policy responses to enhance Indian migrant participation in physical activity and sport in Australia. Thus, this research ensures contributions not only to theoretical knowledge but also to practical implications for policy within the Australian sports and recreational sectors. Chapter 8 details the methods and findings of the concluding policy study.

3.5. Summary

This chapter has outlined the philosophical foundations of the research approach, focusing on the pragmatist paradigm that supports mixed-methods research. It detailed the methodology and research design, justifying the use of both qualitative and quantitative methods to explore the experiences of physical activity among Indian migrants in Australia. The exploratory sequential design was explained, and the subsequent Chapters 4 through 7 detail these qualitative and quantitative studies conducted as studies one to three.

The next chapter, Chapter 4, is titled “A Qualitative Exploration of Perspectives of Physical Activity and Sedentary Behaviour Among Asian Indian Migrants in Melbourne, Australia: How Are They Defined and What Can We Learn?” This chapter explores the definitions and understandings of physical activity and sedentary behaviour. Thereafter, Chapter 5, titled, “Qualitative Insights on the Importance of Sociocultural Contexts on Asian Indian Migrant Participation in Physical Activity and Sedentary Behaviour,” further elaborates on the exploration of contextual influences, concluding the qualitative study design.

CHAPTER 4. A QUALITATIVE EXPLORATION OF PERSPECTIVES OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR AMONG ASIAN INDIAN MIGRANTS IN MELBOURNE, AUSTRALIA: HOW ARE THEY DEFINED AND WHAT CAN WE LEARN?

Fernandes, S., Caperchione, C. M., Thornton, L. E., & Timperio, A.

Prelude

The preceding chapter provided the philosophical and methodological justifications for undertaking mixed-methods research among Indian populations. This chapter begins with the qualitative study of the exploratory sequential design. This qualitative inquiry gave voice to Indian migrants, allowing them to actively participate in the research process. As the lead researcher, I facilitated this inquiry to understand how Indian migrants perceive and define physical activity and sedentary behaviour. Bringing their perspectives on these behaviours provides a foundation before delving deeper into exploring the contextual influences on participation (or lack thereof), which is further explored in Chapter 5. This chapter was published in *BMC Public Health* as "A Qualitative Exploration of Perspectives on Physical Activity and Sedentary Behaviour Among Indian Migrants in Melbourne, Australia: How Are They Defined and What Can We Learn?" Both Chapter 4 and Chapter 5 report on the qualitative findings from the first study conducted within this thesis.

Fernandes, S., Caperchione, C. M., Thornton, L. E., & Timperio, A. (2021). A qualitative exploration of perspectives on physical activity and sedentary behaviour among Indian migrants in Melbourne, Australia: How are they defined and what can we learn? *BMC Public Health, 54*, 118–131. https://doi.org/10.1186/s12889-021-12099-4

4.1. Introduction

Physical inactivity contributes to the global non-communicable disease (NCD) burden, with costs to healthcare systems attributable to inactivity conservatively estimated at INT$[4]53.8 billion globally and further costs associated with INT$13.7 billion in productivity losses (Ding et al., 2016; Lee et al., 2012). South Asian descendants namely from India, Maldives, Pakistan, Bhutan, Sri Lanka, Nepal, and Bangladesh are disproportionately liable for NCD-related mortality globally (Bennett et al., 2018). It is suggested that Indian migrants have a genetic predisposition that perpetuates their NCD risk at younger ages (< 40 years) (Enas & Kannan, 2005; Gupta et al., 2002; Gupta et al., 2009) and present a greater risk of NCDs when compared to western European and other Asian populations (Volgman et al., 2018). The health risk may be greater for Indian migrants when compared to native counterparts (Mahajan & Bermingham, 2004), as health-risks may in part be attributed to having lower levels of physical activity and increased sedentary behaviour in Western countries, such as the US, UK, Canada, New Zealand and Australia (Daniel, Wilbur, Marquez, et al., 2013; Hayes et al., 2002; Kolt et al., 2007; Mahajan & Bermingham, 2004; Tremblay et al., 2006; Williams et al., 2011). The healthy immigrant effect suggests that although recent migrants who fulfill rigorous health screening requirements upon entry have a greater health advantage than their native counterparts, yet over time their health declines (Kennedy et al., 2015). It is suggested that migrant populations from non-western communities may succumb to poor lifestyle behaviours such as low physical activity and increased sedentary behaviour when adapting to westernised national cultures and infrastructure (Bauman et al., 2009). This is critical to consider for a genetically predisposed population, and where socio-cultural influences in the process of adapting to a new country (acculturation) can accentuate the health risk, and over time perpetuate the public health challenge (Abate & Chandalia, 2001; Greenhalgh, 1997). Increasing physical activity among Indian migrants is an important solution in addressing their burden of multiple NCDs, but making efforts to increase physical activity behaviour, and limiting sedentary behaviour necessitate that we understand how such behaviours are defined or conceptualised by Indians in their migrant-setting.

Physical activity is typically defined in the literature as ‘any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen et al., 1985, p. 126). It includes occupational, household, travel, and leisure (e.g., sport, exercise performed for fitness purposes, yardwork) physical activity (Strath et al., 2013). The consensus definition of sedentary behaviour is ‘any waking behaviour that expends energy less than 1.5 METs while in a sitting or reclining or

[4] International $ (INT) was used to allow for cross-country comparisons of the economic burden, all costs were converted to international dollars, following standard practice.

lying posture' (Tremblay et al., 2017, p. 5). These operational definitions, however, may not reflect how the public views these behaviours. Very few studies have explored how culturally, and linguistically diverse migrant populations define or conceptualise physical activity and sedentary behaviour. Qualitative insights revealed that Cambodian, Mexican, Sudanese, and Somalian immigrants and refugee communities living in the United States, had conceptualised their knowledge and practice of physical activity with ideas of purposiveness when engaging in exercise, sport, and household tasks (Wieland et al., 2015). Indian migrants in the United States and Canada defined physical activity as informal and automated behaviour and considered perspectives related to their spirituality and cultural experiences (yoga, pranayama-breathing) (Galdas et al., 2012; Kalavar et al., 2005). In Australia, the different cultural and ethnic identities (family vs individual) were regarded as potential explanations for the 'unplanned' norm of physical activity among Indian and Sri Lankan migrants compared to the planned exercise norm among Anglo-Australians (Gupta et al., 2017). The Culturally and Linguistically Diverse Physical Activity Mapping Project outlined the array of differing perceptions across Indian, Greek, Vietnamese, Filipino, Samoan, Sudanese, Bosnian, Arabic-speaking, and Spanish communities living in Queensland, Australia (Queensland Health, 2010). In that study, Arabic and Sudanese women attributed their ideas solely to weight loss while Indian and Vietnamese described perspectives related to family, work, and social settings. Such perceptions of physical activity and sedentary behaviour within culturally and linguistically diverse populations often differ from the operational definition of physical activity.

Currently how physical activity and sedentary behaviour may be understood among Indian migrants is limited to perspectives from older participants (70+years) (Kalavar et al., 2005), those with a clinical diagnosis (Galdas et al., 2012; Mohan et al., 2008) or considering a single Indian regional sub-culture (e.g. only Punjabi migrants) (Galdas et al., 2012). For a growing Indian population in Australia, understanding how Indian migrants perceive physical activity and sedentary behaviour will be important to tailor their health promotion strategies and interventions (Koshoedo et al., 2015; Queensland Health, 2010). Hence, this study aimed to 1) identify how physical activity and sedentary behaviour are defined by Indian migrants living in Australia; and 2) describe how these definitions are shaped by cultural background and migration.

4.2. Methods

This is an exploratory qualitative study that uses thematic analysis to unravel the meaning and perceptions of physical activity and sedentary behaviour among Indian migrants (Braun & Clarke, 2006). Such an approach has previously served as a framework for revealing conceptual depth

about the thoughts, experiences, and feelings of interest among specific populations (Allen-Collinson & Leledaki, 2015). Semi-structured interviews and the use of prompts enabled the researcher to uncover new meaning and in-depth descriptions of any experience of interest within a free-flow, and personalised setting (Lune & Berg, 2016). The study was approved by the Deakin University Human Ethics Advisory Group-Health (HEAG-H 93_2019) on the 4th of July 2019. Written informed consent was provided by all individuals involved in this study.

Sample recruitment and settings

All interviews occurred in Melbourne, Australia between August to December 2019. Melbourne currently holds the fastest population growth rate of capital cities in Australia, with overseas-born migration the greatest contributor (Australian Bureau of Statistics, 2019). Following England, Indians were the second-largest overseas-born resident population in the state of Victoria in 2016 (Australian Bureau of Statistics, 2019).

Purposive sampling was used to ensure a diverse selection of individuals (Patton, 1990). To be eligible, participants had to have resided in Australia for one year or more, with an intended length of stay of more than two years and be fluent in English. Indian descendants from countries other than India (e.g., Fijian Indians) and those below 18 years and above 70 years of age were not eligible. Those with a reported chronic illness or physical disability that limited their capacity to engage in any physical activity were also not eligible as the interview included questions to explore barriers and enablers of physical activity (not reported here), which may differ substantially for this group. Refugees and new arrivals within their first year in Australia were not included as they may have different experiences concerning these behaviours. Recruitment also sought to include first and second-generation Indian migrants. The criteria for first-generation participants included those born in India, and second-generation included those self-identified as Indians either born or migrated to Australia before the age of 12 with one Indian-born parent. This age cut-off has been used in other studies (Kasinitz et al., 2009; Smith et al., 2012).

Participants were recruited through word-of-mouth, social-media channels (e.g., Facebook), and posters at various community centres, local libraries, local Indian grocery stores, and cultural organisations. Social-media channels and posters included a link to an online survey that directly screened respondents for eligibility. The few respondents who directly contacted the research team member to register their interest in participating were screened for eligibility by telephone. Those who met the eligibility criteria were emailed information about the study. All participants provided written informed consent prior to the start of the interviews.

Procedures

Additional demographic details, for example, household, occupation, education, and reason for migration (open-ended question) were obtained before each interview. Participants self-selected their preferred interview mode, selecting from skype, telephone, or in-person at a public location. Interviews were conducted in English by the first author (SF) for a duration of 35 to 45 minutes. Where appropriate, field notes were used to record post-interview contextual details such as interaction styles and emotions. Considering the diverse participant ages, generation, and sub-cultural profiles, achieving thematic saturation was approximated after 17 interviews wherein descriptions of experiences (richness) were considered adequate for analysis (i.e., sufficient knowledge answering the research aim) and within the allotted timeframe (Bertaux & Kohli, 1984; Guest et al., 2006).

Interview guide

The interview guide (Table 5) was informed by the five-phase-systematic methodological framework for semi-structured interviews (Kallio et al., 2016). It was developed to gather information about the study aims and a broader research question related to influences on physical activity and sedentary behaviour among Indian migrants (not presented here). Participants were first asked questions related to their physical activity, followed by questions about sedentary behaviour. For example, participants were asked "*Describe what physical activity means to you?"* or "*What does the term sedentary behaviour mean to you?*". Prompting cues were used to draw out further detail and participants were encouraged to provide examples to support their ideas and/or perceptions. Prior to conducting the interviews, the questions were piloted on three participants from the target population to ensure that the interview guide was salient and culturally appropriate. After the interview, each participant received a gift card for their time and contribution.

Table 5 *Interview Guide*

Interview route	
Physical activity	Sedentary behaviour
▪ Describe what physical activity means to you? ▪ Is staying active more or less important to you? ▪ Can you give me some examples of type of activities you experience in a typical day? ▪ Context of physical activity: When? Where? With whom? ▪ At present what helps you to engage in physical activity? (facilitators - prompt) ▪ What challenges you to engage in physical activity? (barriers - prompt)	▪ Describe what the term sedentary behaviour means to you? ▪ Can you give me some examples of sedentary activities you experience in a typical day? ▪ Context of sedentary activities: When? Where? With whom? ▪ Describe benefits to engaging in such sedentary activity (E.g., sitting, lying/sleeping)? ▪ Describe negative effects/limitations of engaging in such sedentary activities? ▪ How has current work-life impacted the level of sedentary activity? (facilitators/barriers -prompt)
Prompts as necessary	
Psychosocial: Perceptions, values, attitudes, definitions Institutional: Occupational setting, workplace facilities Social & cultural: Social support, Indian /non-Indian community, traditional/cultural modes/practices Social & material resources: Area deprivation, opportunities in life Physical environment & opportunity: Neighbourhood, parks, open spaces, safety, facilities Migration: Acculturation, equal opportunities, past-present comparisons Health & health communication: Health information, overall health	

Note. This table displays the lead interview questions and potential prompts developed for physical activity and sedentary behaviour.

Data analysis

Each interview was audio-recorded and transcribed verbatim by an external transcription service. Each transcript was checked for accuracy by the first author (SF) before commencing the data coding process. A thematic inductive coding approach was employed using the Braun & Clarke framework (Braun & Clarke, 2006). A codebook, containing codes and a hierarchical structure of overarching codes and sub-codes, was developed, and checked iteratively by the two authors (SF, CC). Overall, coding a single undivided passage of the data was the preferred unit of analysis (Chenail, 2012). Line-by-line coding was also used to identify certain elements within a single unit that added depth to the overall meaning (Thomas & Harden, 2008). Such an

approach enabled a closer view when unpacking novel and important aspects while keeping the broader focus of the overall aims and considering the overall responses of the participant as a single unit (Chenail, 2012). The first author presented the themes and sub-themes separately for physical activity and sedentary behaviour, to all co-authors (CC, AT, LT) who cross-checked, refined, and finalised the themes. The authors discussed the coding process making necessary revisions to the coding framework, addressing general clarifications, ensuring safety standards of data management were maintained. The first author conducted all the interviews and the data analyses. The first author shared similar cultural background as the participants and has previous work experience with Indian migrants and conducting physical activity research tailored to Indian migrants. As a cultural insider, the first author engaged in reflexive practices (e.g., journaling) to ensure rigour and trustworthiness were maintained (Ortlipp, 2008). Collectively, the co-authors were outsiders to the research process who carried the necessary knowledge and expertise to conduct research in physical activity and sedentary behaviour; one co-author has also previously worked with migrant communities. The data and coding were managed with NVivo Software for Mac, Version 12 (QSR International Pty Ltd, 2018). Table 6 provides a sample of nodes, category descriptions and codes of the final coding framework.

Table 6 *Sample Coding Framework*

Top level Nodes	Category [Description]	Codes
Physical activity perspectives *[Ways of defining]*	Importance [Reasons physical activity is important]	Image - aesthetics Improved fitness/function Mental Mental & physical/body weight
	Perceived benefits [Perceptions of the benefits of PA]	Bodyweight (aesthetic): Related to body image [men] Related to body image [women] Energy and function Mental - Mood Physical with mental context Social Other positive health outcomes
	Meaning and definition [Various aspects related to understanding of physical activity]	Being active, moving, not sitting Other aspects: Cultural Connection with mind and body Involves people (social) and outdoor Unconscious over planned
Sedentary behaviour -perspectives	Perceived benefits [Participants views on the benefits of sedentary practices]	Family time No benefit Reading learning Rest relax recover Socialise Work & hobbies Time for self
	Perceived negative consequence	Back & joint, stiffness Brain function & focus Get lazy Health conditions Less social Mood & negative thoughts None with physical activity

	Broader meaning [definitions and understanding of sedentary behaviour]	Weight gain Don't know Not moving, doing nothing, lazy Other- Balance with other activities Cultural - past observations of women's sitting. Cultural - squat and floor sitting
	Overlaps with perceived benefits and consequences	Ideas of duration Ideas on energy expenditure Ideas on posture

4.3. Results

Of 44 individuals who responded, 32 were eligible to participate and were emailed further information about the study and consent forms. Of these, 21 provided written informed consent and completed an interview. Nine interviews were conducted in-person, eight via skype, and four over the telephone. First-generation participants (*n=18*) were originally from diverse regional sub-cultural backgrounds of India: two participants each from Punjab, Maharashtra, Karnataka, Tamil Nadu, Goa, and one participant each from Andra-Pradesh, Delhi, Kerala, Jharkhand, Uttar-Pradesh, Kolkata, Orissa, Rajasthan, Madhya-Pradesh, Jammu, and Haryana. For second-generation (*n=3*), one participant each had self-reported their origins from Kolkata, Karnataka, and Maharashtra. Reasons for migration mainly included seeking education and job opportunities (*n=8*), followed by relocation, or reuniting with their family members (*n=5*), improved quality of life (*n=3*), and to gain overseas experience (*n=3*). Additional participant characteristics are presented in Table 7.

Table 7 *Participant Characteristics*

	Total sample (*n*=21) ***n* (%)**
Gender	
Men	10 (47%)
Women	11 (53%)
Age (years)	
18-35	14 (66%)
36-55	6 (29%)
56-65	1 (5%)
Education qualifications	
University/tertiary degree	21 (100%)
Generation	
First-generation	18 (86%)
Second generation	3 (14%)
Migration information	
Year's resident in Australia	
1<3	6 (29%)
3-10	7 (33%)
>10**	8 (38%)
Age at migration (years)	
<18 **	4 (19%)
19-25	9 (42.9%)
26-35	7 (33%)
36-45	1 (5%)
Current work	
Total hours at work per week	
<20	2 (9.5%)
20-40	14 (67%)
>40	5 (24%)

Household characteristics	
Additional household occupants	
Live alone	3 (14%)
1-2	5 (24%)
3-5	9 (42.9%)
>6	3 (14%)
Children in the household	
0	15 (71.5%)
1-3	6 (28.5%)
Number of drivable motor vehicles	
0	5 (24%)
1	8 (38%)
>2	8 (38%)

Note. ** Second-generation those migrated from India to Australia before 12 years of age with one Indian-born parent.

The qualitative results revealed two overarching themes: 1) The holistic perspective for physical activity sub-themes of which related to mind-body, social, cultural, and environmental perspectives; 2) Broad perspectives of sedentary behaviour mainly related to ideas related to purpose and culture which they weave into the perceived benefits and consequences of sedentary behaviour. Given the disproportionate number of second-generation to first-generation participants, no distinctions by generation were made within these findings.

Perspectives of movement and intensity

The majority of participants described physical activity as "any sort of movement", or "physical exercise" mainly performed for leisure (gym, sport), or active travel (walking, cycling), occupational (shelving), and housework practices (cleaning, cooking, gardening). Some considered not engaging in sedentary behaviour as physical activity. As one man stated, "*The term physical activity to me means working out, doing physical exercise, or walking or jogging or whatever. Just not being sedentary is my definition of physical activity*". Similarly, a woman offered, *"It [physical activity] means moving a lot. Doing things, not sitting"*. Ideas related to intensity and energy expenditure emerged when few participants perceived planned exercise behaviours (gym, sport) required greater physical effort over lower intensity activities such as walking. As one man summarised, *"I like to push myself physically to the limit where my body starts to shut down and almost get exhausted, that to me is exercise, rather than just going for a nice, gentle walk"*.

Holistic perspectives

For some participants, physical activity was not only about engaging in bodily movement but a way of engaging the mind. As one man stated, "*Physical activity means the overall development*

of a person… mentally as well as physically". Such descriptions are summarised by two other participants weaving in this mental perspective in the context of recreational sport and traditional yoga.

> *"For me, it's getting your mind off the regular stuff you do, and it's not just running, it's getting engaged in some kind of an activity where you're not thinking about work or regular day-to-day stuff. For example, tennis is one thing. You're also thinking about the ball. When you're playing cricket, you're thinking about the timing. So, giving your mind a break from the regular day-to-day tasks and activity, that's physical activity for me". [Male participant]*

> *"I realise physical activity doesn't only mean you move your body, you should be aware of every part even when you're exercising, doing yoga, or running… For me, physical activity means awareness to my body, whatever I'm doing". [Female participant]*

Social, cultural, and environmental perspectives

Although women mainly pointed to ideas about physical activity in connection with people and nature (i.e., outdoor environment), one man spoke of his connection of physical activity to nature when stating, *"I don't know, it [trail running] just has a calming feeling when you're running outdoor, with more trees"*. When defining physical activity, one woman stated, *"Like it means working out, working up a sweat. Sometimes physical activity is also being outdoors and walking with friends"*. Similarly, reflecting on her traditional Indian experiences where agriculture was considered the main source of physical activity another woman stated, *"So life changed after moving abroad I think in terms of physical activity. Physical activity for me, [is] being close to nature and then doing something. So that really changed"*. Another woman also emphasised the socio-environmental connection in view of increasing physically active behaviours and reducing sedentary practices: *"I think if you want physical activity, you enjoy it with more people, with more friends, with more nature. I think it motivates you to become less sedentary"*. Ideas of social connection also emerged when speaking about traditional/cultural modes of activity. For instance, one woman shared how traditional festivals that involved cultural dancing perpetuated the social connections with members of their community/culture. Connecting with their community members while engaging in physical activity practices was considered an integral part of the Indian culture.

> *"I think dance is also part of physical activity because it doesn't only make you fit, it makes you happy as well. Overall, all Indians love to dance. I think that's one part of our culture which is amazing. It [Dance] makes people healthy; it makes people engage with others, the social contact which nowadays people are lacking, [is still] there in our culture. When I go back, we have certain festivals where you gather around, like harvesting festival, and dance". [Female participant]*

A small portion of women spoke of how perspectives of physical activity can be shaped by their social-cultural norms and practices. Their descriptions revealed that an Indian experience may not be homogenous but a conglomeration of diverse norms and practices arising from distinctions of class, caste, and regional sub-cultural norms and practices. Describing how nuances of class or caste intersections of Indian culture may shape the gender-based experiences of physical activity these women offered,

> *"…You come from a certain class or a certain caste, where women are expected to do traditional roles. So, a mother is just a mother, and her role is defined. She has got to cook she has got to look after the family. She's not somebody who is encouraged to take up any hobbies". [Female participant]*

Her quote highlights the notion that the social stratifications of class and caste inherent to the Indian culture can position native Indian women to adhere to performing their traditional gender roles. She also pointed to how perspectives and preferences of physical activity for women may be shaped by sub-cultural norms that were important to consider when these women migrate to western settings. She recognised that culturally shaped perspectives and practices of physical activity may not be consistent with perspectives and practices around physical activity in their migrant /western contexts.

> *"With one demography is not the same, from up north to down south. It's [a] different culture, different upbringing. In south India, every family household encourages girls to take part in dance, they should learn [dance], even if they won't take it up as a profession, at least as a hobby they could do it. But that may not be the case in another part of India…but when you come to Australia, you bring those things with you which may not be applicable here". [Female participant]*

Similarly, another woman supported the idea that experiences of physical activity may differ for individuals across the Indian demographic. For her, activities traditionally performed for daily living in her regional subculture shaped her understanding that physical activity was an informal practice, rather than a planned exercise behaviour. Her quote suggests that among men and women in rural Indian agricultural communities, physical work as part of daily living may be viewed as an important and legitimate form of physical activity that creates little distinction along gender lines.

> *"For every individual or every community, every society, physical activity has different meanings. I'm from…. a state mainly famous for agriculture…In my state people give a lot of emphasis on physical activity. So, there was nothing like a cultural difference for men and women. So, for me, doing some sort of physical work comes in the [form of] physical activity even if you're not going to the gym". [Female participant]*

Perspectives of intent or purpose on sedentary behaviour

A small number of participants expressed that they did not understand the meaning of the term sedentary behaviour. However, for most participants, sedentary behaviour conveyed a state of idleness described as "just sitting", "doing nothing", "being lazy" or "not moving" when sitting and lying. Several participants had interwoven other ideas related to the purpose (underlying reason) and duration (length of time). Narrating how the idea of purpose is tied to shaping the meaning and practice of sedentary behaviour, one man stated, "*Like you are just sitting down for nothing, or you are sitting down and doing something creative. It all depends on what you are doing… Being creative or just lying or being lazy all the time?*". Similar ideas of purpose and duration were shared by other participants when stating,

> *"When I scroll down Facebook, for me it's something very important because I just read the news. So, I never included it as a sedentary lifestyle, because to know about the news and politics, I'm very interested. That's why I didn't tell you I scroll down Facebook, and I don't add it to my sedentary life". [Female participant]*

> *"It depends on if it goes on for a while and it starts impacting your health, that's what I believe is sedentary. Whereas having 'me time' sitting, watching TV, having time off once now and then actually is helpful. As long as you're not lying down on the couch for the whole day". [Male participant]*

When exploring past cultural experiences, two participants highlighted how activities of daily living were performed adopting a sedentary 'position' in India. Their descriptions suggested that in India it was customary for them to engage in activities of daily life in a floor-seated or squat 'position'. Such cultural experiences of, or reflections on, sitting or squatting to perform important activities of daily living may in some part underpin views on intent and purpose shaping what is and isn't considered sedentary behaviour.

> *"Most Asian communities, they sit in a certain pattern [squat]. In terms of cooking, our toilets and everything was different, which now I think [is] approved by the scientists and researchers, why it was important to sit in certain behaviours...These kinds of sedentary behaviours really affect when we are coming from [a] certain environment and then jumping to here [Australia]". [Female participant]*

> *"We used to sit a lot more on the floors, back in India, than on the couches, even though we had couches. I definitely think it's one of those cultural things where people prefer just sitting down on the floor a lot more. When I was young, we always used to sit on the floor to eat, to do everything. To do our homework, to study". [Male participant]*

In defining sedentary behaviour, the participants' ideas of intent and purpose also surfaced in discussions of the perceived benefits and consequences of being sedentary, particularly when sitting and lying. For instance, there was a perception that sitting and lying benefitted physical and mental relaxation and essential to connect with friends and family members, however "lazy" was sitting with the intention of "doing nothing" which was perceived as having negative health consequences, such as physical (back/join) discomfort, weight gain, negative mood, and social disconnection. As one woman stated, "*I would put on weight, I would have low moods, I would be not as social as I want to do and not being social and not having friends would create other problems"*. Narrating how the idea/purpose of sitting is essential as it provides holistic health benefits from physical, mental to the social contexts, they offered, *"[sitting] helps you relieve and relax, and come into your good mood, because of stress you had in the job. So, it [sitting] helps you get back to normal*" [Male participant].

> *"It's kind of a bonding time I have with my son. Sitting down is an important part of my life when you have a kid and it should be in anybody's life, I feel... sitting at home with your family, your friends or with my son, I don't think it has any negative impact". [Female participant]*

4.4. Discussion

Among a sample of Indian migrants living in Melbourne, Australia, this study explored how physical activity and sedentary behaviour were defined, further describing how such perceptions were shaped by culture and migration. When defining physical activity, Indian migrants had interwoven ideas of bodily movement with broader ideas related to mental engagement (mind-body), social, cultural, and environmental aspects. For sedentary behaviour, they shared ideas related to purpose and duration when conveying the lack of movement and energy expenditure.

Broader perspectives

The findings agree with previous qualitative studies that found broad conceptualisations of physical activity (e.g., purposiveness, passivity, cultural, familial, social) among Indian migrants, other immigrants, refugees, and native communities at risk of non-communicable diseases (Brangan, 2013; Galdas et al., 2012; Gupta et al., 2017; Kalavar et al., 2005; Koshoedo et al., 2015; Wieland et al., 2015). The conceptualisation of physical activity among non-Indian immigrants and refugees has been attributed more to the social, economic, and environmental factors they experienced in high-income countries and less to their cultural norms (Wieland et al., 2015). However, qualitative insights from studies targeting Indian migrants revealed that Indian migrants experienced and perceived physical activity with ideas related to culture (yoga), spirituality (Hinduism), familial, social, and outdoor environmental experiences, which parallel

the broad ideas expressed by participants in our study (Dave et al., 2015; Galdas et al., 2012; Gupta et al., 2017; Kalavar et al., 2005; Mohan et al., 2008). Such broad perspectives may also stem from Indigenous Indian religion and spiritual traditions and philosophies. Authors in the discipline of Indian psychology emphasised that in addition to dependence, materialism, and collectivism, the established set of attitudes/perceptions of an Indian mindset also involved *holistic* aspects that may vary by the diverse ethnic norms within their society (Bhawuk, 2010). Accordingly, attitudes of knowledge, realities, and existence (i.e. how Indians may think, feel, act) may be distinctive, integrated by diverse aspects such as their physical, social and spiritual experiences (Bhawuk, 2010; Sinha, 2010). Awareness of such cultural/contextual knowledge (perceptions, attitudes, intentions) as often overlooked in physical activity literature, may be useful when tailoring health promotion messages and population-specific physical activity interventions.

Culture & Indian experiences

Gender perspectives

This study expands the insight on the cultural norms and practices that may shape perspectives and experiences of physical activity for an Indian migrant population. The views expressed by women in this study are supported by several studies that previously accounted for the gender-defined roles of Indian migrant women with low levels of physical activity from adhering to their cultural norms and responsibilities (Caperchione et al., 2015; Dave et al., 2015; Lawton et al., 2006; Sawrikar & Muir, 2010; Sriskantharajah & Kai, 2007). While partaking in physical activity during childhood may be culturally encouraged, meeting cultural expectations during adulthood may necessitate the Indian woman to prioritise her time and responsibilities attending to family needs over engaging in physical activity (Dave et al., 2015). Such culturally defined roles may be important to consider when planning physical activity initiatives to engage Indian women, particularly those migrating during adulthood. Previous authors attributed such culturally defined roles to the lower sedentary times (sitting, standing) among South Asian women compared to European women, thus implying that different ethnicities or cultural norms may impact physical activity and sedentary practices (Biddle et al., 2019).

Heterogenous perspectives

The participants reiterated what several authors have previously emphasised, that the Indian population is not homogenous but an amalgamation of sub-cultural norms, values, and practices, including distinctions of caste, class, language, and religion (Bhattacharya, 2011; Dheer et al., 2015; Misra et al., 2000). For instance, Punjabi Indian migrants in the United States

attributed their native agricultural/farming experiences to perceiving physical activity as an informal activity of daily living (Galdas et al., 2012). Similar insights that physical activity was an automated experience, borne from how activities of daily living were performed in the Indian culture, and not attributed as a behaviour that is planned, as the concept of 'exercise' in western cultures (Gupta et al., 2017). Such insights may imply the possibility that the Indian experience may be shaped with distinctive ideas and experiences that may impact an individual's or group's preferences of physical activity which is an important issue for future research involving Indian migrant communities. Such insights can validate our findings, expand, and support existing knowledge that may help inform the tailoring of physical activity interventions for Indian migrants globally.

Reshaping the conventional lens of sedentary 'position'

There is limited literature on perceptions of sedentary behaviour among Indian migrant populations. South African Langa community members that conceptualised inactivity with ideas of 'passivity' beyond solely adopting the 'sitting' position may support our findings (Brangan, 2013). Two participants revealed how traditionally, in India, floor-sitting, and even squatting-positions were being adopted to perform activities of daily life. These findings may be supported by research in other disciplines (e.g. occupational therapy), that identified floor sitting and squatting positions were commonly adopted by Indian (Prakash & Ganesan, 2021; Prakash et al., 2016), and other non-western cultures (Mulholland & Wyss, 2001) when undertaking activities of daily living, and recognise culture plays a significant role in how activities of daily living are performed, particularly among ethnic minorities (Hewes, 1957; Meghani-Wise, 1996). Some also emphasised the need for awareness of such cultural distinctions in behaviour, not only between different countries but also within each national culture, as such practices may vary between the urban-affluent and rural-lower economic dwellers (Gibson et al., 1996; Mulholland & Wyss, 2001). Hewes (1957) 'anthropology of posture', approximated 1000 types of positions adopted across different cultures when performing such activities. It is plausible, therefore, that the operational definitions around physical activity and sedentary behaviour built solely on energy expenditure (sitting/reclining) position and bodily movement (Caspersen et al., 1985; Tremblay et al., 2017) may not adequately reflect the array of such behaviours across different cultures, and possibly within each culture.

Perspectives of purpose and duration

Studying adults in the UK, previous authors note the importance of considering the 'purpose' underlying sedentary behaviour over the level (time, bouts) of sedentary practices (Leask et al.,

2015; Palmer et al., 2019). For instance, perceiving poor health consequences as related to engaging in mindless/passive sitting with prolonged duration, while sitting to socialise with friends and family, or solving puzzles or relaxation were perceived as a beneficial use of sedentary behaviour (Leask et al., 2015; Palmer et al., 2019). Sedentary practices over longer durations were more likely to occur for leisure purposes such as social contexts (Leask et al., 2015). While these studies focus on older adults in the general population, their insights support the participants' perspectives on purpose, duration, and perceived benefits of sedentary behaviour. Such perspectives may be important for a collectivist Indian culture, where social connections with friends, family, and community members form part of their identity and may result in greater sedentary practices in the social/leisure domain than others. More research exploring the contextual/domain-specific experiences of sedentary behaviour of Indian migrants may help identify determinants of their sedentary behaviour.

Holistic perspectives and culturally relevant insights

Overall, the broad ideas in this study support a need for holistic approaches that incorporate physical, mental, social, environmental, and cultural perspectives when researching, communicating, and promoting physical activity among Indian migrants. It may be that to understand their physical activity and sedentary behaviour we should also consider adjustments of their cultural norms, values, and gender roles with migration. This is particularly important when acculturating to a new culture, where migrants are required to adjust/modify their native cultural values and practices to align with the contextual and cultural values and practices of a western setting/culture (Schwartz et al., 2010). For instance, Indian women moving away from their extended family or rural agricultural backgrounds may rethink the broader perspective such as social connection to physical activity from connecting with their community and extended family members, and with lack of social support in their migrant settings, may alter their perspective to consider physical activity as a planned exercise, such as going to the gym. Similarly, they may consider sitting practices important to help build their social connections as migrants. Culturally tailored interventions that have incorporated such holistic approaches have led to improved health outcomes, including physical activity practices among ethnic minority women in Canada (Murdoch-Flowers et al., 2019). Holistic perspectives are particularly important for other ethnic/indigenous communities in Australia and South America, where identities of self and health-related practices are also shaped with ideas of mind-body, social, landscape, psychological, ideas of sharing, familial and communal harmony, and balance of the external world and inner-self (Bautista-Valarezo et al., 2020; Burgess et al., 2005). Giving importance to understanding the impact of migration on re-shaping such indigenous/native expressions of

physical activity and sedentary behaviour in addition to cultural and social influences would complement efforts to support their participation in physical activity.

Limitations

This study solely considered the views of participants fluent in English and did not include any participants older than 65 years. While we sought to include second-generation Indian participants, only three were recruited and no comparisons could be made, limiting the transferability of the findings. Participants were provided with the choice to participate in the interview in-person, by telephone, or online to minimise participant burden. However, these different modes of data collection may have affected responses.

4.5. Conclusions

This study provides a rich and nuanced account of how physical activity and sedentary behaviour are understood and defined among an Indian migrant population. Framing physical activity with a holistic lens and using holistic approaches to promote physical activity are thus encouraged. Cultural behaviours/practices can have implications for how we consider, categorise, and measure sedentary behaviour, diverging from the one size fits all approach. Such insight may improve efforts to tailor interventions and effectively communicate the physical activity-related policy for the Indian migrant population.

CHAPTER 5. QUALITATIVE INSIGHTS ON THE IMPORTANCE OF SOCIOCULTURAL CONTEXTS ON ASIAN INDIAN MIGRANT PARTICIPATION IN PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR

Fernandes, S., Hickson, E., & Richards, J.

Prelude

The preceding chapter revealed the broader views and holistic perspectives of participants on physical activity and sedentary behaviour, focusing on how cultural experiences and migration shape these perspectives and practices. This chapter provides insights into the contextual influences on physical activity and sedentary behaviour among Indian migrants in the Australian context. Chapter 5 was published in the *Journal of Physical Activity and Health* as "Qualitative Insights on the Importance of Sociocultural Contexts in Indian Migrant Participation in Physical Activity and Sedentary Behavior." This chapter concludes the qualitative phase of the exploratory sequential design.

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5.1. Introduction

The Indian population is genetically predisposed to a higher risk of noncommunicable diseases such as diabetes, obesity and cardiovascular diseases (Arokiasamy, 2018). For the Indian population, epigenetics and lifestyle are important considerations, as environments that discourage physical activity and encourage sedentary behaviour may exacerbate the early onset of non-communicable diseases (Hills et al., 2018; Vasan & Thomas, 2012). Migration status is important to consider as it may compound such health risks, particularly with migrants from non-western communities who adapt to unfamiliar physical and sociocultural environments (Bauman et al., 2009). Studies on Indian migrants living in Australia have partly attributed their health risks to having low levels of physical activity and increased sedentary behaviour after migration (Mahajan & Bermingham, 2004; O'Callaghan et al., 2021). Low levels of physical activity are also evident for Indian migrants when living in other western countries such as the United States (US), United Kingdom (UK), Canada, and New Zealand (Babakus & Thompson, 2012). For Indian migrants, understanding the diverse contextual factors that influence physical activity and sedentary behaviour is critical to address their health risks, and improving their quality of life after migration. This is particularly important in Australia, where insufficient contextual insight is thought to have resulted in short-lived physical activity interventions and ultimately the uptake of physical activity among Indian migrant communities (Queensland Health, 2010).

For ethnic minority populations, factors related to migration, health-communication, sociocultural, physical, and occupational settings are particularly important as influences on physical activity and sedentary behaviour (Holdsworth et al., 2017). But some of these contexts are inadequately explored for Indian migrants. In Australia, there is some evidence of the contextual factors that influence physical activity among its Indian migrant population. For instance, the perceived low social support, stress with migration, time constraints, low motivation, and cold temperatures are recurring barriers reported by Indian migrants to engage in physical activity (Gupta et al., 2017). These findings are consistent with the evidence from the US, Canada, and the UK (Caperchione et al., 2015; Daniel et al., 2018; Horne et al., 2013). However, some of the contextual factors drawn from studies on Indian migrants in Australia appear contradictory to findings from studies conducted on Indian migrants in other western countries. For instance, in Australia, Indian migrants perceived facilities and parks as accessible and conducive to engaging in recreational physical activity (Gupta et al., 2017), but, Indian migrants living in the US and UK considered the lack of sidewalks and insufficient access to facilities as barriers (Daniel et al., 2018; Horne et al., 2013). Indian women living in Australia did not perceive cost, language, or lack of information as barriers to engaging in sport and physical activity (Sawrikar & Muir, 2010), but these were barriers reported by women from other

culturally and linguistically diverse communities in Australia (Sawrikar & Muir, 2010), and are often reported as barriers to physical activity for Indian and other South Asian migrant women living in the US, Canada, and UK (Babakus & Thompson, 2012). Further investigation is warranted to not only expand on the contextual factors which remain under-researched for Indian migrants but also to confirm/refute the differences observed and to draw insight into these differences. Therefore, this study aimed to explore the range of contextual factors that influence physical activity and sedentary behaviour among Indian migrants living in Australia.

5.2. Methods

Design and setting

Individual semi-structured interviews were used to draw descriptions of the diverse contextual factors that influenced physical activity and sedentary behaviour. For Indian communities, individual interviews offer an effective way to limit culturally desirable responses (Sinha, 2010) and explore the complexities within their social and cultural contexts (Ghosh, 2019). This study took place in the greater Melbourne region, located in the state of Victoria, Australia. Victoria holds the highest overseas-born migrant population and Indian migrants are the country's second-largest migrant population after the English (Australian Bureau of Statistics, 2022).

Sample

Purposive sampling techniques were used to recruit participants (Patton, 1990). Eligibility criteria included men and women who self-identified as Indian, aged 18 to 65 years, fluent in English, with no reported illness or disability, and were either first- or second-generation migrants. First-generation migrants were born in India. Second-generation migrants were born in Australia or had migrated to Australia before 12 years of age (Smith et al., 2012) with at least one Indian-born parent. Participants had lived in Australia for at least one year, with an intent to live in Australia over the next two years.

Recruitment

Participant recruitment strategies involved the distribution of flyers at local neighbourhood grocery stores and local libraries, and relevant cultural organisations, as well as through word of mouth and online media channels such as Facebook. Most respondents expressed their interest by completing an online eligibility screening form. A proportion of interested participants, who contacted the lead researcher directly, were screened for eligibility by telephone. Individuals who met the eligibility criteria were emailed the study information and consent forms.

Procedure

After receiving written consent, additional demographic details were obtained on household composition, occupation, educational qualifications, and reasons for migration. All interviews were conducted in English via Skype, in person or by phone, and lasted for a duration of approximately 30 to 45 minutes. The interview guide, developed by the lead author (SF) was guided by the systematic methodological framework for semi-structured interviews (Kallio et al., 2016). This guide was developed to sought information on the perspectives of physical activity and sedentary behaviour published previously (Fernandes et al., 2021) and a range of contextual influences on physical activity and sedentary behaviour among Indian migrants presented in this paper. The guide was cross-checked with two external physical activity experts and later pre-tested with three Indian community members to ensure the wording of questions was easy to follow and culturally appropriate. This guide is published elsewhere (Fernandes et al., 2021). After the interview, each participant received a $20 gift card for their contribution. The data was adequate to meet the research aim after 21 interviews (saturation) (Fusch & Ness, 2015). Each interview was audio-recorded and transcribed verbatim by an external transcription service. Each transcript was assigned a participant-identification code to anonymise identifiable details before analysis. All interviews took place between August to December 2019.

Analysis

A step-wise inductive thematic approach guided the analyses of the data (Braun & Clarke, 2019). The initial re-reading of each participant's transcript by the author was done to ensure completeness and accuracy of the meaning and intent of the data. A senior academic expert (CC) reviewed the initial codes, themes, and concepts generated, to ensure there was an unbiased development of codes and the coding framework. They (SF, CC) discussed and refined the codes and coding hierarchy, addressing any discrepancies. Additionally, an external senior physical activity expert (AT) was involved in the critiquing and finalising of the key themes for reporting. All data coding processes were managed with NVivo 12 (QSR International Pty Ltd, 2018).

Ethics

This study was approved by Deakin University Human Ethics Advisory Group – Health (HEAG-H 93_2019). All participants provided written informed consent.

5.3. Results

A total of 45 individuals expressed their interest to participate; of these, 32 individuals met eligibility, and 21 individuals that provided written consent were interviewed. The participants

represented diverse Indian backgrounds: Andra-Pradesh, Delhi, Kerala, Jharkhand, Uttar-Pradesh, Kolkata, Maharashtra, Karnataka, Punjab, Tamil Nadu, Orissa, Goa, Rajasthan, Madhya-Pradesh, Jammu, and Haryana. Table 8 provides additional participant demographic characteristics.

Table 8 *Socio-Demographic Characteristics of Indian Migrants (n=21) Participating in the Interviews (n %)*

Variables	*n* (%)
Gender	
Men	10 (47%)
Women	11 (53%)
Age (years)	
18-35	14 (66%)
36-55	6 (29%)
56-65	1 (5%)
Education qualifications	
University/tertiary degree	21 (100%)
Generation	
First-generation	18 (86%)
Second generation	3 (14%)
Migration information	
Year's resident in Australia	
1<3	6 (29%)
3-10	7 (33%)
>10**	8 (38%)
Age at migration (years)	
<18 **	4 (19%)
19-25	9 (42.9%)
26-35	7 (33%)
36-45	1 (5%)
Current work	
Total hours at work per week	
<20	2 (9.5%)
20-40	14 (67%)
>40	5 (24%)
Household characteristics	
Additional household occupants	
Live alone	3 (14%)
1-2	5 (24%)
3-5	9 (42.9%)
>6	3 (14%)
Children in the household	
0	15 (71.5%)
1-3	6 (28.5%)
Number of drivable motor vehicles	
0	5 (24%)
1	8 (38%)
>2	8 (38%)

Note. ** Second-generation those migrated from India to Australia before 12 years of age with one Indian-born parent.

Contextual factors that emerged as key influences on physical activity and sedentary behaviour related to 1) Socio-cultural contexts, 2) Physical contexts, and 3) Workplace environments. These and other contextual factors for physical activity that are related to activities of daily living and migrant-friendly health communication are reported below.

Sociocultural contexts

Social connection

The participants considered their social connections were important influences on physical activity, particularly, their connection with friends, family, neighbours – referring to individuals and/or family units living in their vicinity, and the wider community. They disclosed such experiences of social connections when living in India and perceived these social connections to motivate their participation in physical activity. As migrants living in Melbourne, in Australia, the majority of participants spoke of the limited social interactions with members of the wider community and perceived this as a barrier to engaging in physical activity. Some perceived the lack of social connection had prompted them to become sedentary after migrating to Australia.

> *"When I moved here, I would say I didn't have any friends or something and people wouldn't prefer walking here or something, like back in India. And my life was sedentary initially and then when I met friends who were engaged in dance and Zumba and swimming, when I met friends there and I could relate it to what life I had back at home. So, then I started engaging in those activities to meet those friends as well as to meet new people here." P9 [Female participant]*

The participants unanimously perceived a lack of social connection with their neighbours in Australia, as a barrier to engaging in physical activity. In describing their motivation to engage in physical activity they spoke of the importance of neighbourhood social connections that they experienced with neighbours when living in India.

> *"In India, you have a stronger community. Your neighbours know you... I used to always have friends over. While here you don't know your neighbours. [In India] your neighbour literally comes past your door and be like, do you want to go for a walk? I'm going for a walk. And you go, alright, yeah, I'll come. And oh, I'm going to the beach, do you want to come? You always had people asking you to do things." P11 [Female participant]*

Role of cultural and mainstream physical activity in building social connection

Many participants acknowledged the importance of Indian traditional dance, sport, games, and festivals to form social connections among migrants and to educate second-generation Indians

on their cultural history and traditions. To some participants, Indian cultural associations were sites to integrate them with other members of their Indian community and to engage in their cultural forms of physical activity.

> *"I joined the [regional] Association. Because they have 7-8 functions a year that they honour [regional] food and [regional] traditions...I'm also a member of an [Name] Indian Association. So, they also have different types of activities. They play housie bingo... Dancing…if I go to an association, I'm meeting 10 people at the same time." P4 [Male participant]*

However, descriptions of one woman brought into question the lack of effort to use Australia's sports and recreational practices to integrate migrant communities with local Australians. Comments below are indicative of such views:

> *"For instance, the big game here is footy [Australian Rules Football]. I have never really seen someone making an active effort to make an outsider aware of the sport. What about footy for outsiders? We'd like to know [about] the sport. But it's only played here, nowhere else. So definitely we didn't have access to it before coming here. I think knowing something like footy would definitely help you integrate. It's a big part of the culture. Like footy is as local as you can get." P10 [Female participant]*

Social & material resources supporting social connections

Participants reported greater self-motivation to engage/adhere to physical activity practices when using activity trackers such as pedometers.

> *"They gift me a watch [activity tracker] so that I start walking. It has increased [my] walking habits. It has decreased my sitting habits...It is the reason why I walk. Yes. Because now I can keep a count of the steps I have. If it wouldn't be there, I wouldn't know how many steps I walk through the day and how many hours I was sitting. So, it even gives the calorie count that I have reduced through the day, so that helps." P9 [Female participant]*

Several participants sought various online social platforms for opportunities to connect and engage in physical activity with members of the wider community.

> *"...I live in the west side of Melbourne, I've been trying to find some meetups [app] close by where people do engage in tennis, and I haven't been able to find a good group there. But I found one group in [name of suburb]…These kinds of apps they help…" P3 [Male participant]*

Physical contexts

As residents in Melbourne, Australia, most participants observed the availability of facilities to engage in sports and other recreational activities. The majority of the men spoke of greater

access and availability of facilities for recreational sports and gym-based activities in Australia than in India. To summarise this view, a man who perceived having a more active lifestyle in Australia than when living in India stated:

> *"After coming to Australia, I definitely got into it [Tennis] and I do all sorts of physical activities. It [physical activity level] has gone up many folds...The reason primarily is easy access to all these sports facilities here… Because in every suburb practically you can find a tennis court and a volleyball court and gyms almost in every street." P16 [Male participant]*

Women highlighted barriers to accessing such facilities, particularly in the long term, due to the high membership fees and lock-in contracts associated with using these facilities. For example: "…*whatever indoor activity you do, it costs you money. That is a constraint…."* P15, and *"they have these lock-in contracts. I don't want to restrict myself…"* P10*.*

The participants perceived the built environment features within Melbourne such as "trails", "playgrounds", "reserves, parks, gardens", "special roads" (referring to dedicated walking paths) and "cycling tracks" as facilitators for walking, running, and cycling practices. Few barriers that emerged related to the limited access to parks during renovations, the lack of parking spaces, and the distance to the park. Describing this positive experience from built environmental features on cycling behaviour a man stated, "*Even on the road they keep space for bicycle riders, respecting the bicycle riders and giving them [the] way. It's a very good experience I have received here."* P21 [Male participant]. Leading into this description he highlighted fewer environmental hazards to engaging in physical activity behaviours in Australia stating, "*In Mumbai, you don't even get a little bit of place to move around, because of the traffic and a lot of encroachment on the roadside…In Australia, everything has its space and beauty. It has been maintained every time."* Comparisons to India also revealed that women felt safer engaging in outdoor physical activity like walking.

> *"I wouldn't consider India a safe place to walk down a creek by yourself, at odd hours. It's fine here because the crime rate is lower. Our crime rate is pretty high. As a woman it's more a gender thing, I don't know how boys feel about walking around a creek at night, but I would think twice. I realised it's safe, so I used to go there." P10 [Female participant]*

Workplace environment

Most participants believed desk jobs and long work hours prompted sedentary practices. One man stated, "…*because I am in IT, most of the time I'll be sitting in a chair doing my work*" P16.

Another woman, a student, spoke of the online delivery of university education as a catalyst for sedentary practices among Indian students in Australia:

> *"Even studying makes you sedentary, right. And here everything is online. You can take a book and walk out, but you can't take your computer and walk on the streets. You can't study like that. You can take a book to the park and come back." P10 [Female participant]*

Some participants recognised opportunities where through their job they perceived engaging in incidental physical activity. As a student and part-time worker in hospitality, one woman stated, *"My job involves running food and cleaning up, we're on our feet and walking around all the time. So that keeps me active, and I'm happy about it. Back home I wouldn't have a job like this."* P10. IT professionals described using lunch breaks to exercise. As one man summarised, *"I always keep an extra set of the running clothes at work and take that lunch break to go for a half an hour run. Come back, take a shower, and use that lunch break to do your exercise*." P3.

Other contexts

Activities of daily living: housework and car dependence

For several participants in India, many household tasks were either outsourced or shared between family members. After migration, the lack of family support and access to affordable labour required men - particularly unmarried students, and women to perform their daily household chores. Women and men reported greater engagement in household-related physical activity in Australia than in India.

> *"The activities have increased a lot …. here, all people live independently. Here he [male] does the role of a housewife because he cooks food, he takes care of himself, he does the cleaning and cooking and getting all the groceries. So, I think these are the three roles that every individual whoever comes here plays in his life which he never experienced before back in his country. Because we've got our servants and maids who work for us... Before I used to not do anything, I used to sit all day long." P5 [Male participant, student]*

Additional to shifts in household behaviours, participants also reported a shift in transport behaviour. Many indicated their reliance on public transport from not driving/owing cars in India which resulted in more incidental walking practices. As migrants, women reported greater reliance on cars which replaced their walking practices, becoming sedentary in Australia. One man offered, *"… In India, I didn't have a car. So, we walked everywhere, or we took a bus or train. But here we have a car"* P4. The quote below substantiates these views on the dependence on cars in Australia.

> *"I'm not going to drive to Safeway [grocery store in the vicinity] or the supermarket in India. I'll walk for 15 minutes, or 10 minutes, but I'll Walk. And that doesn't happen here... You can't walk 45 minutes for one coriander. You will drive.....That's a huge difference in the lifestyle. And that has influenced the way I live, because, within two years of coming to Australia, I put on a lot of weight, because I started to drive. I drive around. I never used to drive back home in India." P15 [Female participant]*

Migrant-friendly health communication

Several participants, when prompted, had revealed differences in the messaging, access, and support of the Australian health care system and allied health practitioners. Summarising these differences between India and Australia, a woman offered, *"[Here] You have more opportunities [with allied health care] that comes from state-wide or [a] national initiative which I can't even imagine in India. And the value and importance* of *physical activity is stressed, it's spoken about."* P14. Another man stated, *"I don't think in India they're doing anything about it [diabetes], whereas over here if they see your blood sugar levels are high, they'll give you a [exercise] program. They want to intercept. They want to treat it early."* P13.

5.4. Discussion

These results show a range of contexts that influence the physical activity and sedentary behaviour of Indian migrants living in Melbourne, Australia. Social contexts were important to engage/adhere to physical activity in India and Australia, but the perceived lack of social connection after migration emerged as a key barrier. In Australia, built environment features like dedicated walking paths, cycling tracks and availability of public places were perceived as facilitators to engage in physical activity. Working environments that fostered long periods of sitting emerged as a catalyst for sedentary behaviour. Other contextual influences on physical activity and sedentary behaviour related to activities of daily living, namely the lack of household help and dependence on cars, and migrant-friendly health communication.

This study supports previous evidence on the perceived lack of social connection to engage/adhere to physical activity and sport reported by Indian migrants when living in western countries like Australia and the US (Daniel et al., 2018; Sawrikar & Muir, 2010). For Indian men and women, the perceived lack of social support can trigger feelings of loneliness, depression, low self-esteem, perceived incompetence and failure, which are viewed as acculturative stressors after their migration (Bhattacharya, 2011; O'Callaghan et al., 2021). The participants' views on group-based physical activity can be a solution to buffer such acculturative stressors and barriers to physical activity participation in western countries. For some, cultural groups

facilitated building connections with members of the Indian community allowing them to engage in their cultural forms of activity (e.g., dance). For others, mainstream sport and physical activity provided 'a way' to build their connections with non-Indian Australian communities. The need to engage in mainstream sports *and* maintain their cultural practices may stem from inheriting collectivist and individualist social norms/attitudes (Dissanayake et al., 2015). To serve the integration of Indian migrants with members of the wider community, not only is the building of their social capital via cultural events and festivals important but also, addressing the limited use of mainstream sports (Smith et al., 2019), like footy in Australia. Group-based programs that also integrate self-monitoring tools like activity trackers could further persuade Indian migrants to participate/adhere to physical activity (Kandula et al., 2016).

Promoting opportunities for social connections is critical in all areas; previous research shows that individuals living in socially isolated settings are at greater risk of physical inactivity despite the easy access and availability of recreational parks and sporting facilities (Josey & Moore, 2018). Social settings are important for ethnic migrants, given their likelihood to engage in outdoor physical activity may rest on having a positive perception of their social environments (Halbert et al., 2014). Among Indian women who were aware of their local parks and recreation facilities, first-generation Indian migrants considered parks mainly for children, while second-generation Indian women were not only aware of their local parks and recreation facilities but also used their neighbourhood parks to socialise and engage in exercise (Bhatnagar et al., 2021). Among park users in western countries, the perceived lack of social interaction may result from the differing social and cultural norms between the mainstream population and migrants who may also negotiate their sociocultural norms to adhere to the privacy rules in local urban public parks (Horolets et al., 2021). Effectively intervening in the interplay between social environments and physical settings can draw implications to promote outdoor physical activity in locations with high numbers of Indian migrants, particularly in Melbourne, Australia. Such an intersectional lens may particularly benefit first-generation migrants and support the recommendations that urban parks in western countries reflect/accommodate the sociocultural needs of migrants (Horolets et al., 2021).

The participants' views on the long hours spent sitting and the nature of their job is consistent with research that recognised some job types, e.g., desk-based jobs, can contribute to overall patterns of sedentary behaviour (Smith et al., 2016). After migration, Indians living in the UK reported low physical activity levels and low energy expenditure from engaging in jobs demanding long hours of sitting; whereas before migration, they engaged in labour-intensive agricultural jobs (Sarkar et al., 2017). Sedentary workplaces populated with Indian migrant

workers should tailor policies that promote 'active' walking meetings/discussions, lunch-time initiatives like yoga or walking groups or incentives for Indian workers with the highest step counts (Australian Capital Territory, 2016). In considering the social contexts, mixed culture programs, and newcomer incentives could also support the integration of new Indian migrant workers/students.

The participants recognised the value of messaging the importance of physical activity through Australia's medical and allied-health practitioners which aligns with previous studies (Gupta et al., 2017; Kalavar et al., 2005). To support Indian migrants to meet daily physical activity recommendations, it may be useful to communicate information on the components of physical activity such as type, intensity, and duration, by medical and allied-health practitioners. As seen in Canada, messaging the importance of physical activity using physician-prescribed methods, could limit sedentary behaviour and physical inactivity of Indian and other South Asian migrants (Mathews et al., 2007). Earlier evidence shows among the 68% of Australian health professionals who were aware of the national physical activity guidelines, only 16 % were familiar with such components of physical activity (Freene et al., 2019). Educating physicians and allied health professionals with knowledge of the type, duration and intensity of physical activity could be one solution (Litchfield et al., 2019), but, for Indian migrants, tailoring such messages to the social and cultural contexts is essential; as recently found, religious beliefs were important for health practitioners to consider in the healthcare consultation and management of Indian migrants in Australia (Ahmad et al., 2022). Indian migrants who are accredited exercise professionals could accompany/assist medical and allied practitioners to tailor and communicate these components of physical activity after screening or during regular health check-ups (Tulloch et al., 2006). Any co-design attempts should prioritise consulting with cultural insiders who carry evidence-based insights and lived experiences of sport and physical activity in Indian and western contexts.

The participants' views on replacing transport (walking) behaviours in India with their dependence on cars in Australia are consistent with previous research on Indian migrants in the US (Kalavar et al., 2005). Previous work shows that to navigate traffic congestion from limited infrastructures in India, women preferred to walk, particularly for short distances, and men who owned vehicles depended more on two-wheelers than the convenience of cars (Rahul & Verma, 2017). With the improved infrastructure of the west, cars may become a convenient mode of transport for Indian migrant men and women to depend on. But, as one woman highlighted, with changes in the distance to local grocery shops (physical contexts), women who preferred to walk such distances in India may depend on cars in Australia. Such contextual comparisons are

needed and often overlooked in understanding why Indian migrant men and women have low physical activity levels.

Understanding the changes in socio-cultural norms may partly explain the views men and women provided about engaging in housework. This may be explained by the long-standing social stratifications within the Indian class and caste system that supports social positions into which certain families/individuals are born, based on several factors such as their education, income, religion, or professional status (Black, 2016). Looking at the educational qualifications, which are generally representative of the wider Indian migrant population in Australia (Australian Bureau of Statistics, 2023), it appears that these participants could come from higher socioeconomic backgrounds. Individuals who belong to the higher socioeconomic order often carry financial privileges that enable them to outsource inexpensive labour to assist with house-related tasks. Such native-held privileges may be weakened within western sociocultural norms that postulate equality for all people. Hence, after migration, those receiving limited/no help for family members, men and/or women, may be tasked with the need to perform housework duties on their own.

Strengths and limitations

This is the first study to explore a broad range of contextual influences on both physical activity *and* sedentary behaviour among Indian migrants. By making comparisons of such behaviours with their native contexts, India, this study adds insight into an understudied Indian migrant population. The use of a cultural insider researcher may be considered a strength in the design and conducting of the study (Irvine et al., 2008), enhancing rigour through shared cultural knowledge, establishing rapport for conversational depth, and judgement of criteria, particularly the inclusion of the diverse Indian backgrounds, often overlooked in previous studies. However, despite adopting reflexive practices, it is important to acknowledge the presence of researcher(s) bias inherent to qualitative methods. The results also need to be interpreted in light of the small number of second-generation participants and the absence of non-English speakers who may experience different barriers and facilitators. The educational background of this sample could also limit the generalisability of these findings to Indian migrants with lesser education. A mixed-method approach that considers the inclusion of non-English Indian migrant speakers, from diverse socio-economic and religious backgrounds, would offer a useful opportunity to corroborate evidence and confirm the generalisability of these findings.

Future recommendations

From these qualitative insights, a recommended approach could consider an interplay of the variety of contextual factors that shape how physical activity behaviours are formed within their everyday interactions of life. Programs that reflect multiple components that result in physical, psychological, *and* social benefits show promise in improving the uptake of physical activity among Indian migrants (Kandula et al., 2016). Engaging insiders remains essential to service knowledge and cultural blind spots in codesign attempts and to support policymakers and health practitioners, particularly those from non-Indian backgrounds for whom cultural training is recommended.

5.5. Conclusions

From exploring a range of contexts and making contextual comparisons with their native experiences, in India, this study deepens the insight into the contexts of physical activity and sedentary behaviour of Indian migrants in Australia. In particular, the diverse contextual changes with migration and how sociocultural factors may intersect with other contexts like physical environment, health communication and their activities of daily living. Recurring barriers in the social contexts require being cognisant of the cultural complexities inherent within the Indian population. Engaging cultural insiders and prioritising integrated approaches would benefit codesign attempts and tailoring planned policies/programs for promoting migrant uptake of physical activity and limiting sedentary behaviour.

CHAPTER 6. ADAPTING SURVEYS FOR ASIAN INDIAN MIGRANTS: EXPLORING EXPERIENCES OF PHYSICAL ACTIVITY AND SPORT IN THE PRE- TO POST-MIGRATION CONTEXT

Fernandes, S., & Hinckson, E.

Prelude

This is the first study to develop a culturally appropriate questionnaire incorporating a pre- to post-migration design with context-specific measures for Indian migrants. The chapter explains how qualitative insights from earlier chapters informed the adaptation of a culturally appropriate survey for Indian migrants in Australia. Identifying existing measures that best reflect the Indian migrant social and cultural experiences was a crucial step to informing the quantitative examination of key social and cultural factors influencing physical activity before and after migration described in the next chapter. Chapter 6 is presented as a manuscript for journal submission. Accompanying Appendices G to J provide information on the revisions during the adaptation process for the final survey. This chapter represents the second of four studies in the thesis.

6.1. Introduction

It is important to consider the impact of migration on participation in physical activity and sport particularly for individuals moving from their country of origin to a host country. Migrants often need to adapt to new environments by acquiring new behaviours or modifying existing practices (Kuo, 2014). This adaptation may influence levels of physical activity and sport participation, a critical component as a modifiable behavioural factor for individuals from South Asian backgrounds at increased risk of non-communicable diseases such as type 2 diabetes and cardiovascular diseases (Arokiasamy, 2018; Sidhu et al., 2016). Among the South Asian demographic, Indian migrants not only have a genetic predisposition to non-communicable diseases but also present low physical activity levels after migration to their host country (Fernandez, Everett, et al., 2015; Mahajan & Bermingham, 2004). Understanding the contexts influencing the physical activity of migrant populations, such as Indian migrants, is important for the development of effective solutions to increase physical activity uptake and address the global burden of disease (Bansal et al., 2023).

In addition to migration, contexts such as health communication, social and cultural environments, and physical environments play a role in influencing physical activity behaviour among ethnic minority populations (Holdsworth et al., 2017). However, many of these contexts remain under-researched, and existing instruments such as the International Physical Activity Questionnaire and the Global Physical Activity Questionnaire—commonly used to measure physical activity —are limited in their ability to capture diverse contexts (Bull et al., 2009; Craig et al., 2003). While these instruments measure overall physical activity and domain-specific physical activity, they are not tailored to measure the contextual aspects of migration and culture. To meet the need for more nuanced physical activity measures for migrants, specifically Indian migrants, the authors propose the development of a culturally adapted survey instrument focused on this demographic living in Australia. This study is part of a broader exploratory mixed-method research design on Indian migrants in Australia. Specifically, this study aims to refine, contextualise, and pretest a culturally appropriate survey instrument to examine the sociocultural contexts and overall physical activity and sport participation of Indian migrants before and after migration. Recognising the importance of sociocultural contexts is vital for supporting members of migrant communities in making choices that enhance their physical activity engagement in their host countries.

6.2. Methods

This study draws on the contextual domains identified by Holdsworth et al. (2017) as influences on the physical activity behaviours of ethnic minority populations living in high-income countries. These domains include migration, social and cultural settings, health and health communication, psychosocial contexts, occupational contexts, physical environment and opportunity, and social and material resources; each is accompanied by a group of factors related to physical activity behaviours. These domains could illuminate the links between migration contexts and other sociocultural determinants of physical activity for Indian migrants.

Participants

Purposive sampling (Patton, 1990) was employed to select individuals willing to articulate their experiences and opinions, particularly on the survey's overall design, content and process (Bernard, 2017). Research experts were selected to identify potential issues with the questionnaire, such as ensuring the instructions and cues were appropriately detailed and that the scales and items aligned with the study's objectives. Cultural experts, in particular, helped ensure that the questions and response options were culturally relevant to the participants' pre- and post-migration experiences and that the wording respected the community's social and cultural norms. They also assessed whether the timeframe to complete the questionnaire was realistic, whether the information sheets were clear and comprehensive, and whether the overall process flowed smoothly for participants.

Invitations were emailed to research experts and cultural representatives identified from the research team's network and general internet searches. Eligible research experts included four men from diverse European cultural backgrounds, all with expertise in designing surveys and/or social network analysis instruments relevant to migrant populations. Indian cultural experts consisted of four men and three women selected based on specific criteria: They were representatives of the Indian migrant population residing in Melbourne for at least one year, with plans to stay for more than two years, aged between 18 and 70 years, proficient in English, and without any disabilities that limited their involvement in sport and/or physical activity. Selection criteria for first-generation cultural experts included individuals born in India. Second-generation cultural experts were Australian-born, or individuals born in India who moved to Australia before turning 12 years of age and had at least one Indian-born parent. The 12-year-old age cut-off aligns with previous studies (Kasinitz et al., 2009; Smith et al., 2012). This research was conducted in Melbourne, Australia, which has a significant migrant population, and the largest Indian migrant community in the country (Australian Bureau of Statistics, 2022). All

pretesting occurred between May and August 2023. The Auckland University of Technology Ethics Committee granted ethics approval (ref no. 22/223).

Data collection

A modified Delphi technique

This study modified the classic Delphi method (McKenna, 1994) using a modified Delphi technique (Fink et al., 1984; Hasson et al., 2000) to gather expert opinions to refine, contextualise, and pretest the questionnaire within its qualitative approach (Brady, 2015). A simple majority was defined as agreement among at least six of the eleven total experts requiring over 50% agreement (McKenna, 1994). The plan for this process was as follows: if consensus was not reached within the first three rounds, up to five additional rounds would be considered. If consensus remained elusive, the process would halt, with a final review by the team members.

The data collection process that actually took place consisted of three rounds as follows:

a. External review

Each research expert received an email with the online survey link, accompanied by the study information sheet, consent form, and a separately attached Checklist A. Checklist A prompted researchers to review the survey's content, question type, and the survey's overall completeness. Cultural representatives were emailed the online survey link, prefaced with their corresponding information sheets, consent form, and a separately attached Checklist B. Checklist B carried prompts to review the survey's overall content and process, replicating the intended process to be administered to a larger sample of Indian migrants in Melbourne. Both checklists provided additional space for participants to note discretionary feedback. These checklists are available in Appendix H. All participants signed the online consent (Appendix C) form before completing the survey and checklist. A short report on the research insights was offered in return for their contribution.

b. Independent feedback sessions

The lead author conducted independent feedback sessions with research experts to identify potential issues in the design of the overall instrument. These sessions aimed to challenge any assumptions held by the authors that were evident in the draft survey. Soliciting independent feedback proved critical in identifying potential solutions for issues, particularly regarding items on the network analysis component and specific issues outlined in each expert's checklist. These sessions took place over Zoom or the phone over two weeks, with each session lasting

approximately 30 to 40 minutes. The lead author took field notes to revise the survey based on the feedback received.

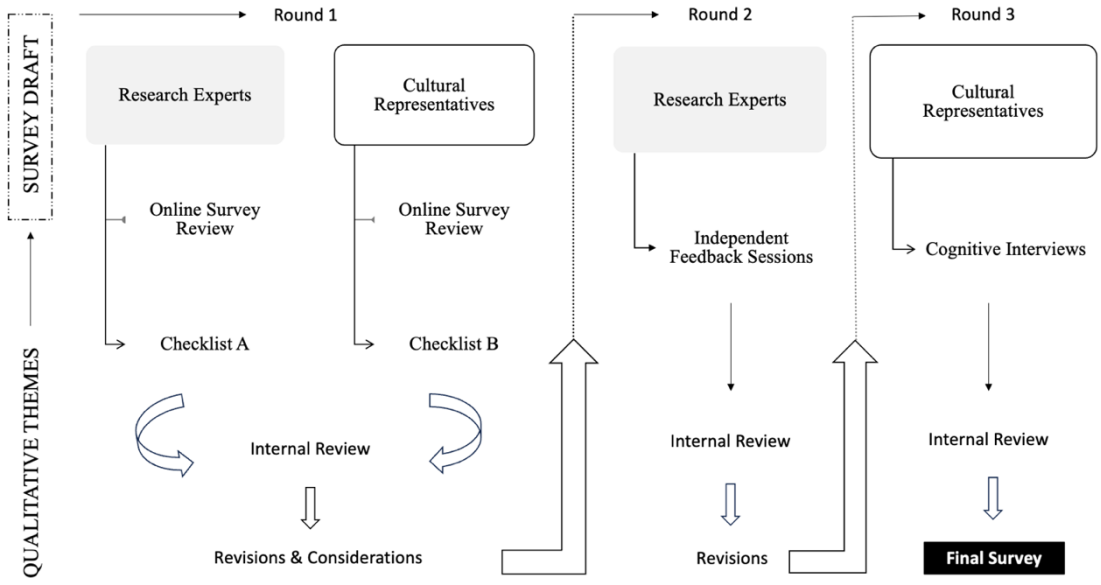
c. Cognitive interviews

The lead author conducted cognitive interviews with five cultural representatives to independently elicit their understanding of items in the survey (Collins, 2014; Drennan, 2003). Each representative independently verbalised their thought process in deciding how to respond to 10 selected items. These interviews were partially scripted beforehand with questions such as, “What do you understand by ...?” and “Why did you select (a reference to the participant’s response)?” Field notes taken during these interviews informed further revisions, particularly by highlighting any statements participants found difficult to understand and instances where limited response options made it hard to recall and provide the necessary information. All interviews took place via Zoom or phone lasting 30 to 45 minutes.

Internal reviews

Both authors initially reviewed the collective feedback received on the checklists and expert feedback sessions to confirm revisions to the initial survey draft prior to pilot testing. Supporting discussions between the authors regarding the feedback received from cultural representatives via interviews helped finalise the survey for administration to the wider Indian migrant population. Figure 8 presents the overall approach as a stepwise illustration.

Figure 8 *Stepwise Illustration of the Modified Delphi Approach*



Note. This figure is adapted from Nasa et al. (2021).

Data analysis

Descriptive coding was used to analyse the information received from the checklists and from the corresponding field notes documented during the independent feedback sessions. This coding method enabled the descriptions of the content and categorisation of information by themes based on the criteria within each checklist and field notes (Saldaña, 2021). The lead author pilot-tested the initial coding choices with two sets of field notes and two checklists, in order to assess potential categories and coding structures. The coding framework was reviewed and discussed with all authors, with no interpretive discrepancies raised. For the interviews, field notes from each participant's responses were combined and aggregated with the information from the pilot survey responses. The aggregated notes were analysed to identify themes reflecting deviations from the intended interpretations of the survey items. Where there was little agreement on the wording of a particular item, one solution was to define the intended meaning of that item within the survey. For instance, for the item 'I am one with (India/Australia)', we added a note prompting participants to consider their responses in light of the people, culture, and values of the mentioned country. All data management processes were executed using NVivo 12.0 software (QSR International Pty Ltd, 2018).

6.3. Results

Fifteen experts were initially approached to pretest the survey. Of these, two did not meet the eligibility criteria, one did not respond, and one dropped out during the first round, resulting in a final count of 11 experts who actively participated in the pretesting process. Among these 11 experts, nine provided initial reviews and feedback on the online survey. This group included six experts in survey design within public health and physical activity research. From this group of six experts, two experts were of Indian background. The remaining three participants were first-generation representatives of the Indian migrant community in Melbourne, Australia. In the second round, only research experts participated in the independent feedback sessions. Their collaborative efforts led to a consensus on revisions to the survey, which were further assessed by cultural representatives in the subsequent round. In the third round, three first-generation cultural representatives from the initial round were joined by two additional second-generation cultural representatives. Pretesting concluded after this round, as the survey was deemed comprehensible, with no further issues identified.

Participant characteristics

Participants came from diverse professional, cultural, and academic backgrounds. Indian migrants represented diverse native Indian backgrounds, such as Jharkhand, Andra Pradesh,

Karnataka, Tamil Nadu, Madhya Pradesh, and Goa. Maintaining such a diverse group of experts provided representative information to address the aims of cultural appropriateness, refining processes, and providing contextualisation within a qualitative approach (De Villiers et al., 2005). Additional participant demographic characteristics can be found in Table 9.

Table 9 *Participant Demographic Characteristics for Research Experts and Indian Cultural Representatives (n=11)*

Variable	*n* (%)
Gender	
Men	7 (64)
Women	4 (36)
Research Experts	4 (100)
Professional background	
Academic research (non-Indian)	4 (36)
Social network analysis	2 (18)
By location	
Australia	2 (66)
Other (New Zealand; Ireland)	2 (66)
Cultural Experts	7 (64)
Professional background	
Academic research (Indian)	2 (18)
University student	2 (18)
Other industry professionals	3 (28)
By generation	
First generation	4 (86)
Second generation	3 (14)
By Location	
Australia	7 (100)

Drafting the survey

Sourcing survey questions through qualitative data synthesis

Thematic insights from previously published qualitative interviews revealed that the social, cultural, and neighbourhood forms of social capital, and health communication contexts, were key influences on physical activity among Indian migrants in Australia (Fernandes et al., 2021; Fernandes et al., 2023). These insights informed the refinement of existing survey questions and the development of the network instrument. For example, participant quotes from multiple interviews were used to identify key constructs and refine existing survey questions regarding social networks, neighbourhoods, and health communication (Table 10).

Table 10 *Examples of Qualitative Quotes and Themes Configured into Specific Constructs and Survey Items Using the Contextual Domains of Influence on Physical Activity Behaviour Among Ethnic Minorities*

Qualitative Data/Quotes	Survey Item	Qualitative Themes/Sub-themes	Construct	Key Contextual Domains and Factors
"When I moved here, I would say I didn't have any friends or something and people wouldn't prefer walking here or something, like back in India. My life was sedentary initially and then when I met friends who were engaged in dance and Zumba and swimming, when I met friends there and I could relate it to what life I had back at home. So, then I started engaging in those activities to meet those friends as well as to meet new people here." P9	Looking back over the last 6 months who are the key people you join to take part in sport or PA? - Enter the names of the sport or PA you think this person engages in.	Networks for sport and PA	Social networks (post-migration)	Social and cultural Social support* Social influences* Peer group
"In India, you have a stronger community. Your neighbours know you... I used to always have friends over. While here (in Australia) you don't know your neighbours. (In India) your neighbour literally comes past your door and be like, do you want to go for a walk?" P11	In [India/Australia], people around your neighbourhood are willing to help their neighbours.	Lack of neighbourhood social connection	Neighbourhood experiences (pre- to post-migration)	
"For instance, the big game here is footy (Australian Rules Football). I have never really seen someone making an active effort to make an outsider aware of the sport. What about footy for outsiders? We'd like to know (about) the sport. But it's only played here, nowhere else. So, we didn't have access to it before coming here. I think knowing something like footy would help you integrate. It's a big part of the culture. Like footy is as local as you can get." P10	Do you know anyone who… - Invites you to attend a sport/physical recreational event.	Information for sport/physical activity	Network resources (post-migration)	Social & material resources Opportunities in life* Financial limitations

"[In Australia] You have more opportunities [with allied health care] that comes from state-wide or [a] national initiative which I can't even imagine in India. And the value and importance of physical activity is stressed, it's spoken about." P14.	- Have you ever been provided with physical activity advice or recommendations by a health professional?	Primary health care experiences* (messaging, initiatives, early intervention)	Health communication (pre- to post-migration)	Health and health communication Primary health care
"My job involves running food and cleaning up, we're on our feet and walking around all the time. So that keeps me active, and I'm happy about it. Back home I wouldn't have a job like this." P10	Select your occupational status in [India/Australia]	Long hours of screen-based sitting and the nature of work	Job type (pre- to post-migration)	Institutional Occupational physical activity*
"After coming to Australia, I definitely got into it [Tennis], and I do all sorts of physical activities. It [physical activity level] has gone up many folds …" P16	In [India/Australia], name the sport/ physical activity you took part in the last 12 months. Recall how many times and the duration you took part in each activity	Physical activity: sport*, changes,	PA patterns (pre- to post-migration)	Other domains*

Note. * = Lesser-known contextual factors

Pretesting the survey

The survey pretesting process involved three key stages (Robinson & Leonard, 2024). Appendix I provides additional examples of feedback and revisions from each round.

a. External review

Cultural representatives considered the overall content and process to be "good," "interesting,", and feasible within the proposed time frame; they also effectively highlighted the survey's focus on the differences between India and Australia. Research experts raised concerns about the process of nominating individuals within the network analysis component and the process for participant contact details. Researchers from non-Indian backgrounds suggested involving cultural representatives to review the survey's content to ensure the language and meaning were suitable to the Indian population.

b. Independent feedback sessions

The lead author conducted independent feedback sessions with research experts to identify potential issues in the design of the overall instrument. These sessions narrowed in on discussions concerning the network instrument, particularly highlighting the assumption that participants had up to five people to engage with in a physical activity or sport. Consensus was reached on including a question to screen the number of people participants could engage with in physical activity or sport. There were agreements about incorporating additional behavioural questions for participant-nominated individuals to enrich the use of the network instrument. A consensus was reached to transition to an anonymous format for participant anonymity.

c. Cognitive interviews

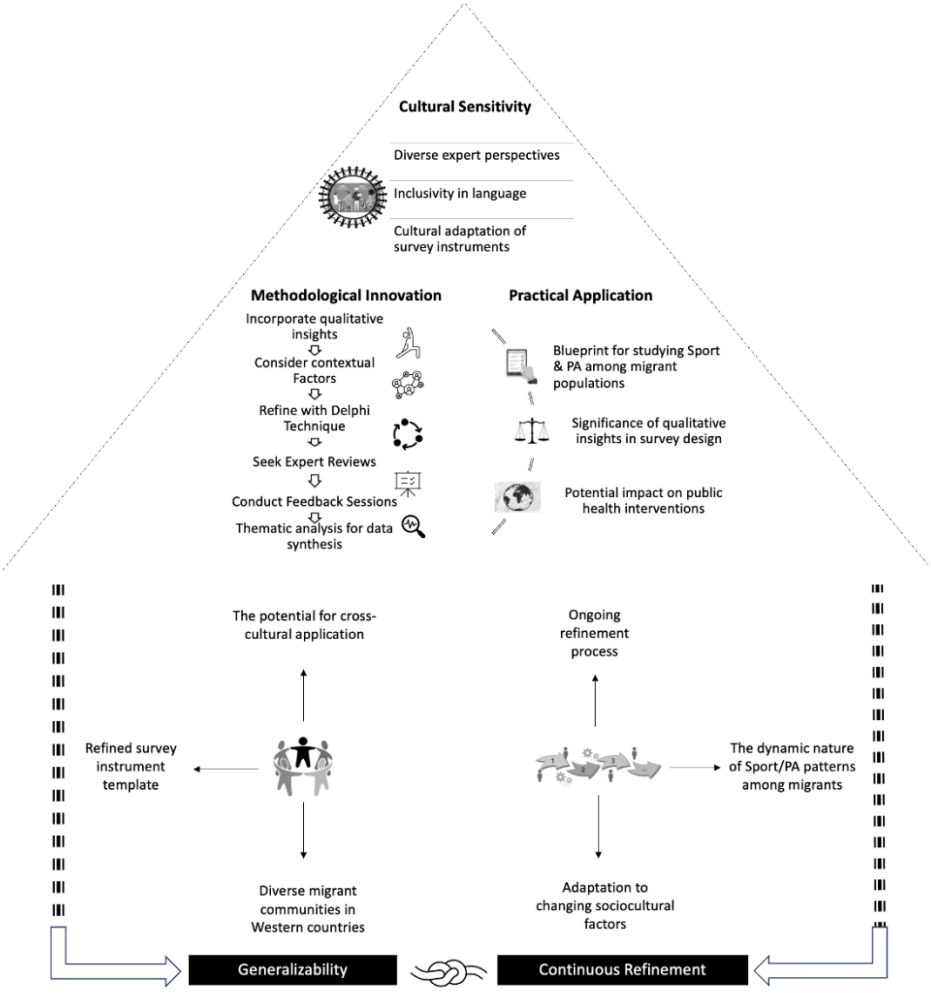
Cultural representatives understood most items (92/95 = 97%) and response options, indicating that they could think about and discuss their own experiences of sport and physical activity both in India and Australia. Two participants questioned the relevance of neighbourhood items and proposed clarifying their inclusion. We added a prompt informing participants about research on how neighbourhood settings can impact physical activity levels. A few statements presented some ambiguity in relation to being able respond confidently. For these statements, their meaning was defined within the survey for clarity. For instance, for the survey item, 'I feel one with [India/Australia]', the survey prompted participants to consider responses with a deep connection with the people, culture, and values of the respective country. Participants reported no difficulty with the response options or the need to recall information about their lived experiences in India. No additional content was suggested, and no further revisions were made

to the existing survey draft. All items (100%) were retained after an internal review, and the draft was finalised for research with the wider Indian migrant population in Australia.

Final survey

The final survey comprised six sections covering eligibility screening, questions on duration, frequency, type of physical activity, and country-related contextual experiences for neighbourhood social cohesion, health messaging, and demographics. It totalled 95 items and included Likert-type, multiple-choice, and open-ended questions. Appendix J illustrates the final survey structure. The survey, administered online via Qualtrics, required 20 minutes for completion, with instructions provided for each section. The final version is available on request or via the link provided in Appendix K. Figure 9 illustrates the key factors and contributions, along with future trajectories in survey-instrument design for migrants in physical activity and sport.

Figure 9 *Key Factors, Contributions and Future Trajectories in Survey Instrument Design for Migrants in Physical Activity and Sport*



6.4. Discussion

This study reports the development of a culturally appropriate survey instrument for a pre- to post-migration comparison of contextual measures of physical activity focusing on Indian migrants in Australia. The survey incorporates a network instrument to address gaps in understanding the relational connections between social networks and physical activity/sport participation. Using a modified Delphi technique, this study offers methodological insights into refining, contextualising, and pretesting a culturally appropriate survey instrument designed to measure sociocultural correlates of overall physical activity and sport participation. Pretesting involved research experts and cultural representatives, enabling the validation of the survey's content to align with the cultural context and experiences of Indian migrants. Discussions on pretesting strategies to minimise measurement errors are detailed. The survey's potential adaptability for use in a single study allows the measurement of contextual influences on physical activity among various Indian migrant groups in high-income countries.

This study leveraged the thematic insights from previous interviews conducted with Indian migrants in Australia (Fernandes et al., 2021; Fernandes et al., 2023). These qualitative findings effectively captured the contextual factors that emerged as key influences on Indian migrant physical activity and sport participation. These insights were operationalised as constructs of interest, thereby guiding the overall objective of the survey. For instance, previous thematic insights revealed distinctions between contextual settings in India and Australia on physical activity behaviours which led to designing a pre- to post-migration comparison of contexts with corresponding scales/items. Additionally, the development of a network analysis instrument allows for a deeper examination of the perceived lack of social connections often reported in studies on Indian migrants in host countries, such as Australia and the US (Bhattacharya, 2008; O'Callaghan et al., 2021). The limited examination of migrants' social networks may arise from the lack of valid instruments examining their social networks for physical activity and sports in their host settings. Constructing a network instrument enhances the understanding of the relational links between existing behavioural patterns and characteristics of the personal networks migrants engage with concerning sport and physical activity (Crossley et al., 2015). Such insights are crucial for developing effective, culturally relevant strategies to promote physical activity and sport participation among Indian migrants in high-income countries.

To pretest the instrument, the study adopted a modified Delphi approach - a consensus strategy leveraging expert opinions to address identifiable problems during the survey design thinking process (Turoff & Linstone, 2002). The Delphi methodology included expert reviews, independent feedback, and cognitive interviews. These techniques were specifically chosen to

mitigate potential measurement errors arising from participants' poor comprehension of response options when recounting their experiences, particularly in the context of comparisons between countries (Blair & Piccinino, 2005). The involvement of an expert panel representing diverse professional and cultural backgrounds presents a comprehensive attempt for all possible perspectives to be identified and thoroughly discussed (Blair & Piccinino, 2005). In this study, the feedback from research experts and Indian cultural representatives on the network instrument prompted valuable modifications, including a screening question to assess the number of individuals the participant engaged with in physical activity. Network specialists provided insights that led to the incorporation of additional behavioural questions for nominated individuals. For example, "To your best knowledge, enter the names of the sport or physical activities you think this person (nominated person) engages in. Please indicate how often do you join this person in sport or a physical activity." Such revisions enhanced the utility of the network analysis, providing a more comprehensive understanding of personal networks in the context of physical activity. Similarly, in responding to expert concerns about personal details, the study transitioned to an anonymous survey, respecting participant privacy. This shift enhanced ethical considerations without compromising confidentiality.

Engaging representatives of the target migrant population in cognitive interviews proved invaluable for identifying additional comprehension issues with survey items before finalisation (Drennan, 2003). These interviews not only facilitated further revisions to survey features but also provided a deep understanding of participants' reasoning behind their difficulties in comprehending specific items (Blair & Piccinino, 2005). For example, during probing, local Indian migrants expressed a lack of confidence in responding to a particular item, citing ambiguity and causing problems in understanding its meaning. Relying on participants' indications of difficulty through probes proved to be a reliable and trustworthy approach, surpassing speculative considerations of non-existent issues in the survey (Conrad & Blair, 2004, 2009).

Although this cognitive interviewing method may not offer statistical proof of the instrument's validity, it provided insights that guided the authors in making informed decisions on further survey revisions based on participant-generated information (Willis, 2004; Willis & Artino, 2013). Participants in the study went beyond the issue of identification and offered suggestions, such as incorporating a statement of purpose to clarify why neighbourhood contexts were included in a survey focused on physical activity and sports. Involving local Indian migrants not only addressed comprehension challenges but also used their feedback to enhance the survey's overall clarity and relevance. The iterative process of probing and feedback contributed to the refining and tailoring of a culturally appropriate questionnaire.

This study has some limitations. The survey's reliance on the English language limits inclusivity by potentially excluding Indian participants whose first language is not English, and others from non-English-speaking backgrounds. While translation could address this, future research should pretest any such translation for comprehension among the target group (Sousa & Rojjanasrirat, 2011). The self-report nature of the survey introduces limitations related to participant recall of information from different time points, specifically regarding pre-migration experiences, and details about individuals nominated in the network instrument. Future studies should weigh these limitations against the benefits of self-reports in capturing the context and various types of physical activity across countries (Prince et al., 2008; Sattler et al., 2021). In the pretesting process, it would be useful to expand the sample size to include native cultural experts, such as individuals residing in India who have not migrated, as their insights into cultural and religious factors may also influence participant experiences. Such information could help refine the design and validate the results of this study. Additionally, purposive sampling methods may be beneficial given the focus on sociocultural factors within the survey (Andrade, 2020). However, researchers must consider that the generalisability of findings from purposive samples is inherently limited to the specific population represented – namely, Indian migrants – and may not apply to broader populations.

6.5. Conclusion

This study is the first to design a pre- to post-migration comparison of contextual measures of physical activity and incorporate a network instrument to explore existing networks for sport and physical activity among Indian migrants. As highlighted by Bhattacharya (2008), there is a recognised need to understand how pre-migration sociocultural norms affect post-migration social behaviours by merging qualitative and quantitative approaches. The development of a network instrument fills a gap in the literature on the relational links between social networks in the context of physical activity and sport tailored to Indian migrants. The methodological insights gained from grounding survey constructs in the rich descriptions of Indian migrant populations enhance the value of qualitative findings, particularly in exploratory mixed-methods studies. The authors anticipate that administering this questionnaire would provide insights into the contextual factors influencing Indian migrant physical activity behaviour before and after migration to high-income settings.

CHAPTER 7. SOCIOCULTURAL CORRELATES OF PHYSICAL ACTIVITY AND SPORT AMONG ASIAN INDIAN MIGRANTS IN AUSTRALIA: A PRE- TO POST-MIGRATION OBSERVATIONAL STUDY

Fernandes, S., & Stewart, T.

Prelude

The preceding chapter described the process of adapting and pretesting a culturally appropriate survey instrument for Indian migrants. This chapter reports on administering the adapted survey to a cohort of Indian migrants in Australia and reports on the associations between changes in key sociocultural factors and changes in physical activity levels from before migration to after migration. The chapter is written as a manuscript for submission to a peer-reviewed journal. Chapter 7 marks the quantitative phase of the research, and is the third study in the thesis.

7.1. Introduction

Migration experiences along with various contextual factors play a crucial role in shaping an individual's ability to maintain an active lifestyle after migrating from their country of origin to a host country. As migrants adapt to their new environment, diverse factors such as length of residence, sociocultural influences, the physical environment and opportunity, and health system communication can significantly impact their physical activity behaviours (Holdsworth et al., 2017). These factors can often differ substantially from those in the migrants' country of origin, making the transition to an active lifestyle more complex. The 'healthy immigrant effect' suggests that while recent migrants have undergone rigorous health screening upon entry, and initially enjoy a health advantage over native populations, this advantage tends to diminish over time (McDonald & Kennedy, 2004). As migrants adjust to new environments, changes in their social, cultural, and physical contexts, including decreased physical activity levels, altered dietary habits, or reduced access to health resources, can contribute to this health decline. In many high-income countries, including Australia, national physical activity guidelines recommend regular physical activity to achieve optimal health outcomes (Australian Department of Health and Aged Care, 2021). For Australia's exponentially growing migrant population, it remains critical to understand how these contextual shifts are associated with physical activity engagement for promoting migrant active lifestyle practices and improving their health outcomes.

In Australia, the Indian migrant population has grown rapidly to now surpass the Chinese community as the largest ethnic migrant population (Australian Bureau of Statistics, 2023). Among South Asian populations, Indian migrants are at heightened risk due to carrying a genetic predisposition making them susceptible to the early onset of non-communicable diseases, particularly type 2 diabetes and cardiovascular diseases (Arokiasamy, 2018). For this population, not only are genetic factors important but their combination with the wider determinants of population-level transitions, such as epidemiological, demographic, nutritional, environmental, social-cultural and economic factors, may result in higher susceptibility of Indians to cardiovascular diseases at lower risk thresholds compared to other populations (Kalra et al., 2023). Physical activity is a modifiable risk factor and presents a potential strategy for addressing these health risks for this group. Yet, several studies show that Indian migrants tend to have low physical activity levels both in India and after migrating to high-income countries such as Australia (Mahajan & Bermingham, 2004), the US (Misra et al., 2005), the UK (Bhatnagar et al., 2015), and New Zealand (Kolt et al., 2007). While social and cultural factors have been identified as key barriers to physical activity engagement, very little research has explored how the social and cultural factors change from before to after migration, especially for Indian migrants. Given

this gap, this study aimed to explore the key contextual factors and their impact on physical activity levels among Indian migrants pre- and post-migration.

The primary research question guiding this study was: What is the association between sociocultural correlates and overall sport and physical activity levels among Indian migrants living in Australia, pre- and post-migration? The specific aims are:

1. To determine the change in physical activity levels and type of physical activity from pre- to post-migration, and
2. To identify key sociocultural factors associated with changes in physical activity levels from pre- to post-migration.

We hypothesised that Indian migrants may not meet the recommended Australian physical activity guidelines after migration. Their participation in sport and physical activity would decrease compared to pre-migration levels with possible differences in the type of sport or physical activity practised between India and Australia. Changes in their physical activity levels are likely linked to pre-migration experiences of neighbourhood social environments and exposure to advice on physical activity recommendations that may differ between the two countries. We anticipated that these factors do not operate independently; they work in complex interconnected ways that can be difficult to predict. The impact of any single factor on physical activity may vary potentially by age, length of residence, and regional Indian ethnicity, and the overall effect on an individual's change in physical activity levels would depend on how these factors combine and interact.

7.2. Methods

Study design and setting

This cross-sectional retrospective study is part of a broader research project examining contextual influences on physical activity, sport, and sedentary behaviour participation among Indian migrants in Australia. Such cross-sectional study designs are widely used in examining associations of a range of factors on health-related outcomes within Asian populations (Wang et al., 2022) including the Indian contexts (Shetty et al., 2025; Srivastava et al., 2021). Data were collected cross-sectionally through an online survey initially administered in the state of Victoria, later extended to New South Wales and Western Australia. Victoria has the largest overseas-born and Indian migrant populations in the country (Australian Bureau of Statistics, 2022). Auckland University of Technology Ethics Committee granted ethics approval (AUTEC 22/223). All participants provided informed consent. This study followed the Strengthening the Reporting

of Observational Studies in Epidemiology (STROBE) guidelines (von Elm et al., 2008) available as Appendix L.

Validation of the survey

We pretested the survey to ensure a culturally appropriate and contextually relevant survey of key pre- and post-migration experiences for Indian migrants in Australia. The survey incorporated key constructs identified from previous qualitative insights (Fernandes et al., 2021; Fernandes et al., 2023) on Indian migrants in Australia including neighbourhood social capital, health communication, physical activity levels, and types of sport and physical activity. Pretesting involved a sample of 11 individuals comprising diverse Indian cultural representatives (Jharkhand, Andhra Pradesh, Karnataka, Tamil Nadu, Madhya Pradesh, Goa) and senior researchers with expertise in survey design, migrant physical activity, and public health. The process included an initial review of the online survey, followed by brief qualitative interviews to gather independent feedback from both research experts and cultural representatives. Revisions were made following a consensus-based approach to resolving any identified issues.

Participants

Non-probability convenience and snowball sampling (Wang & Cheng, 2020) ensured the selection of eligible participants aged 18 to 70 years, who self-identified as Asian Indians, fluent in English, with no disability preventing participation in sport/physical activity. Participants had to have lived in India for at least one year and in Australia for over one year, with an intended stay of more than two years. This ensured participants had sufficient experience with the sociocultural and physical environments of both countries with an age criterion aligned with Australian physical activity guidelines for adults. Refugees were excluded due to their distinct needs including visa requirements and contextual experiences that challenge self-reported data in social and cultural research studies (Lott, 2005). The estimated sample size of 384 was based on the Indian population in Melbourne (242,635), using a 95% confidence interval and 10% margin of error.

Data collection

This survey was administered using the Qualtrics platform. Recruitment included flyers, posters and digital advertisements shared at relevant places of worship, neighbourhoods, libraries, Indian community and medical centres, and Indian grocery stores, across Indian organisations, and online social media and news platforms. Previous studies used similar recruitment sites (Daniel, Wilbur, Marquez, et al., 2013; Mahajan & Bermingham, 2004).

Respondents who contacted the primary researcher, referring to the details in the flyer, were emailed the survey link. Respondents who clicked the survey link answered brief screening questions to confirm eligibility. Eligible respondents reviewed the study information screen before completing the survey. After completing the survey, participants had the opportunity to enter a draw for a gift voucher. These participants had provided their contact details which were deleted after distributing the gift vouchers. As the survey was anonymous, no contact details were retained, including details of those who directly contacted the researcher. Data collection took place from October 2023 to June 2024.

Measures

Change in sport and physical activity participation levels was the primary outcome variable. Independent variables included fusion identity, neighbourhood forms of social capital, health communication, and demographic variables. These variables were assessed once for India and once for Australia. The wording was adapted to each country, as shown in the examples provided below.

Sport and physical activity

Participants listed the sports or physical activities they had engaged in when living in Australia during the previous 12 months, including the frequency as days per week and duration expressed as minutes per day. This question was adapted for India to read as follows, "*Please name what sport or physical activity you took part in when staying/living in India. You have the option to name up to 10 different activities. Recall approximately how many times and the duration you took part in each activity. Start with the one you spent the most time doing.*" This question was adapted from the AusPlay national survey, which provides population-level data on sport and physical recreation participation in Australia (Australian Sports Commission, 2023). The type of activities was regrouped according to Appendix M. For example, type of activity or activity focus constituted muscle strengthening, aerobic, both activities, or no activity, and type of participation constituted as team, individual, cultural, both types, or no activity. The average weekly dose of physical activity was calculated in minutes by summing all reported activities and whether participants met the Australian physical activity guidelines of at least 150 minutes per week post-migration. The AusPlay survey is widely used in cross-sectional survey-based studies on sport participation and leisure-time physical activity among adults in Australia (Hassett et al., 2021).

Fusion identity

The identity fusion scale, originally developed in Spanish (Gómez et al., 2011), measured four specific factors: Feelings of connection with India (e.g., "I am one with India"; 3 items), reciprocal strength with India (e.g., "I am strong because of India"; 3 items), feelings of connection with Australia (e.g., "I am one with Australia"; 3 items), and reciprocal strength with Australia (e.g., "I am strong because of Australia"; 3 items). For each country, India and Australia, these factors were grouped into two general categories of identity fusion: feelings of connection and reciprocal strength. Participants responded on a Likert scale (0 = strongly disagree, 6 = strongly agree), with higher scores indicating a greater degree of identity fusion. Both the Spanish and English versions of the original scale demonstrated similar factor structures and strong evidence of convergent, discriminant, and predictive validity across samples from Spain, the US, and immigrants from 22 countries (Gómez et al., 2011). This scale has been previously adapted and used in studies on Colombian migrants living in Chile (Henríquez et al., 2021).

Individual-level neighbourhood attachment and neighbourhood forms of social capital

Questions from the Los Angeles Family and Neighbourhood Survey (L.A. FANS) (Carpiano, 2007), assessed neighbourhood-level social cohesion, social capital, and individual-level neighbourhood attachment. Five questions on social cohesion and social support assessed whether respondents perceived their neighbourhood as close-knit, trustworthy, helpful, friendly, and sharing common values. Five additional questions assessed informal social control including the likelihood that neighbours would intervene if children in the neighbourhood were skipping school, or vandalising property, and whether adults are watchful of the neighbourhood. Social leverage and neighbourhood organisational participation were each assessed with a single item assessing the participant's engagement in any local voluntary association in the past year, such as neighbourhood block meetings. All items used Likert-type scales, with some items reverse-coded, where higher values indicated stronger associations.

Health communication

The general practitioner's physical activity recommendation scale assessed exposure to physical activity advice from general practitioners over the past year. Detailed descriptions of this scale are available in a prior study conducted in Australia (Short et al., 2016). This scale first asks participants whether they ever received physical activity advice from a health professional, with response options for whether it was in the past 12 months, earlier, or never. A follow-up question identified the health professional who provided the advice (e.g., general practitioner, personal

trainer, exercise physiologist, physiotherapist, nurse, or other). Those who received advice answered additional questions about the type of physical activity recommended (e.g., aerobic, resistance, flexibility, balance exercises) and whether a specific amount of time was suggested. If a specific amount was recommended, participants were asked to describe the details (e.g., "30 minutes per day, five days a week"). Responses were used to create dichotomous variables reflecting the specificity of the advice, including whether both duration and frequency were specified. Finally, a dichotomous variable was created to indicate whether participants had received advice from a general practitioner in the past 12 months.

Demographic variables

Demographic variables included age (years), gender (male, female, prefer not to say), and country of birth (India, Australia, other). Indian-born participants provided birth region and birth state to capture their cultural affiliations. Variables collected for both pre- and post-migration timepoints included membership in a sport or recreational organisation/club with responses "yes" or "no". The categories for length of residence were 15 years or more, 11 to 15 years, 6 to 10 years, and 1 to 5 years. The categories for occupational status were student, employed, both (student and employed), unemployed, and other (including retired or unknown).

Statistical methods

For all statistical analyses we used Microsoft Excel for Mac 2011 and R statistical software (R Core Team R., 2024). Each statistical analysis was selected to address each research aim, with a significance level set at $\alpha = 0.05$, treating the individual participant as the unit of observation. All missing data were removed pairwise during the analysis.

Descriptive analyses summarised participant demographic and physical activity characteristics. Continuous variables are presented as means while categorical variables are reported as counts and percentages. Culturally affiliated demographic data followed the regional classifications established in previous research on the Indian population (Dheer et al., 2015). The categories used for grouping reported types of physical activity and sport into activity type and activity focus are available in Appendix M.

Aim 1: To assess changes in physical activity levels from pre- to post-migration, change scores were computed for each participant's reported physical activity levels pre- and post-migration in minutes per week. A paired t-test assessed the difference in physical activity levels from pre- to post-migration.

Next, a series of chi-squared (χ^2) tests of independence identified how physical activity type and focus, and key sociodemographic variables, changed from pre- to post-migration. Cramer's V represented the magnitude of change from pre- to post-migration, with thresholds interpreted following Lee (2016). All expected counts exceeded 5.

Aim 2: To explore the sociocultural factors associated with changes in physical activity levels from pre- to post-migration, a linear regression analysis was performed treating the change in physical activity level, measured in minutes per week, as the dependent variable.

Simple linear regression (unadjusted model) was used to explore the association of each independent variable with the outcome. These variables were age, fusion identity, social cohesion, social support, social control, social leverage, individual-level neighbourhood attachment, length of residence, gender, neighbourhood organisation participation, and membership status. A subsequent, stepwise multiple linear regression analysis controlled for potential confounders and identified the aggregate combination of variables that best explained the change in physical activity pre-to-post migration.

We used the performance R package to visually inspect model residuals and the ggeffects package to calculate the marginal effects of each independent variable. The R^2 statistic reported the model fit.

7.3. Results

Figure 10 *Participant Selection Process*

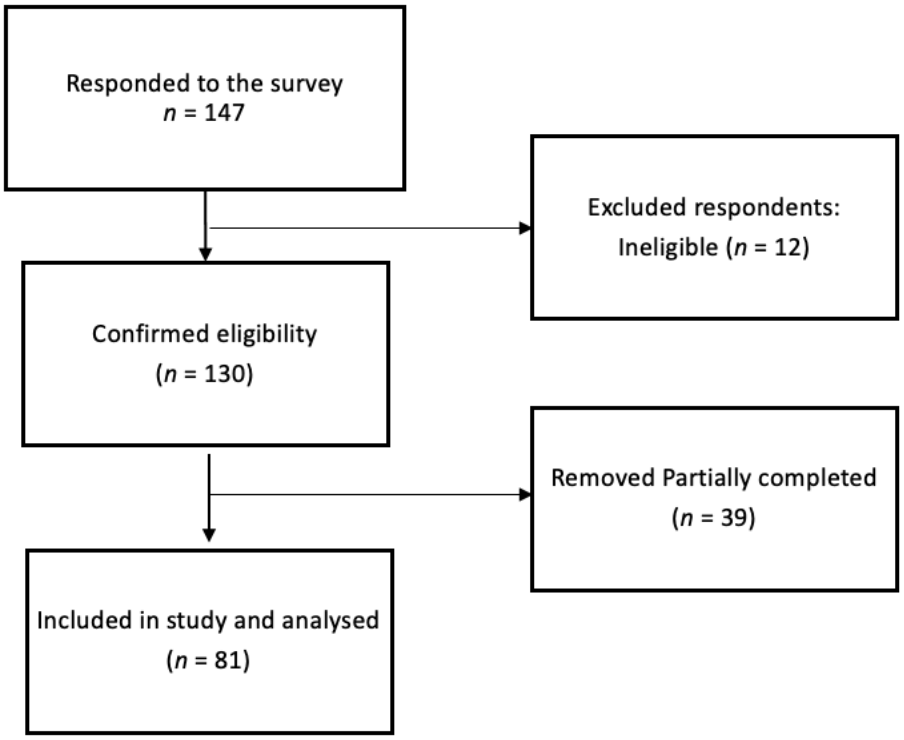


Figure 10 shows the participant selection at each stage of the study. The mean age of the sample (*n*=81) was 41.5 years. Table 11 provides additional individual and cultural details highlighting demographic characteristics such as gender, and country of birth, as well as regional and state representation within India. The median age computed for the sample, 39 years, was slightly higher than the broader Indian migrant population in Australia (35.9 years) (Australian Bureau of Statistics, 2023). The gender distribution was 53% men and 47% women, aligning with the Australian census data that shows a higher proportion of Indian men (54.2%) compared to women (45.8%).

Table 11 *Participants' Demographic Details*

Individual Characteristics	*n* (%)
Gender	
Men	43 (53.09)
Women	38 (46.91)
Country of Birth	
India	75 (92.59)
Another (Kuwait, Kenya, UAE, Uganda, United Kingdom)	5 (6.17)

Australia	1 (1.23)
Cultural Affiliations	
Regional Representation	
South	20 (29.85)
Northwest	14 (20.89)
Southwest	12 (17.91)
West	7 (10.45)
East	4 (5.97)
Central	4 (5.97)
North	2 (2.98)
Far East	1 (1.49)
Northcentral	1 (1.49)
Union Territories	2 (2.98)
State-Wise Representation	
Punjab	8 (11.94)
Maharashtra	7 (10.45)
Kerala	6 (8.95)
Gujarat	6 (8.95)
Tamil Nadu	5 (7.46)
Delhi	5 (7.46)
Goa	5 (7.46)
Karnataka	5 (7.46)
West Bengal	1 (1.49)
Andhra Pradesh	1 (1.49)
Other States and Union Territories	18 (22.86)

Participants reported a slightly higher average mean time spent on physical activity per week in India than in Australia. A paired samples t-test showed this decrease in physical activity as statistically significant from pre-migration to post-migration (M_I = 167.49, SD = 139.9; M_A = 132.98, SD = 99.23; t = 2.14, p = 0.036).

Pre- and post-migration comparison of key variables

Table 12 describes the changes in activity focus and type of participation before and after migration, along with other key categorical sociocultural variables.

Activity focus

The chi-squared test showed significant changes in activity focus from before to after migration, χ^2 (3, n = 81) = 25.69, p < 0.001, with a moderate effect size (V = 0.398). When living in India, most participants focused on aerobic activities (39.5%). After migration to Australia a slightly larger proportion of participants engaged in muscle strengthening (Post: 4.3%, Pre: 1.2%) and both aerobic and muscle-strengthening activities (Post: 24%, Pre: 8%).

Type of participation

There were significant changes observed between physical activity participation types (team, individual, cultural, both, or no activity) from before to after migration, χ^2 (4, n = 81) = 28.43, p < 0.001, with a moderate effect size (V = 0.418). After migration to Australia, individual participation increased from 7.4% to 26.5%, while team participation dropped from 18% to 8%. Cultural participation was absent after migration, and fewer participants engaged in multiple activity types.

Health communication

A statistically significant association was found between receiving physical activity advice before and after migration χ^2 (1, n = 81) = 6.65, p = 0.001), with a small effect size (V = 0.215). In Australia, 36% of participants received physical activity advice, compared to 25% in India. In India, most received advice from medical professionals (general practitioners, nurses), followed by exercise practitioners (fitness professionals, physiotherapists). In contrast, in Australia, the majority received physical activity advice from exercise practitioners, with 19% reporting advice from both medical and exercise professionals, compared to 7% in India.

Demographic variables

With migration, occupation status χ^2 (4, n = 81) = 25.01, p < 0.001, V = 0.39), and length of residence χ^2 (3, n = 81) = 41.94, p < 0.001, V = 0.51), showed statistically significant associations with a moderate effect size. While the proportion of students decreased pre- to post-migration, the proportion of employed participants increased from 19.8% to 37% post-migration. A greater proportion (38.3%) of participants lived in India for over 15 years followed by those who lived between 11 to 15 years (6.8%). A greater proportion of participants had resided in Australia for 15 years or more (13.6%), followed closely by those who were residents for one to five years (13%). Participants' membership status showed no statistically significant association with migration χ^2 (1, n = 81) = 0.66, p = 0.416, V = 0.08), with a slight increase in membership post-migration (post: 20%; pre: 17%).

Table 12 *Chi-Squared Results for Categorical Variables Pre-and-Post Migration (n=81)*

		Pre-Migration n (%)	Post-Migration n (%)	χ2	*p*-value	Cramer's V
Activity Focus	Aerobic	64 (39.5)	33 (20.4)	25.69	**< 0.001**	0.398
	Muscle Strengthening	2 (1.2)	7 (4.3)			
	Both	13 (8.0)	39 (24.1)			
	No Activity	2 (1.2)	2 (1.2)			
Type of Participation	Team	29 (17.9)	13 (8.0)	28.43	**<0.001**	0.418
	Individual	12 (7.4)	43 (26.5)			
	Cultural	2 (1.2)	0 (0.00)			
	Both	36 (22.2)	23 (14.2)			
	No Activity	2 (1.2)	2 (1.2)			
Occupation	Student	26 (16.0)	5 (3.1)	25.01	**<0.001**	0.393
	Employed	32 (19.8)	60 (37.0)			
	Both (Student, Employed)	17 (10.5)	10 (6.2)			
	Unemployed	5 (3.1)	4 (2.5)			
	Other (Unknown, Retired)	1 (0.6)	2 (1.2)			
Length of Residence	15 years or more	62 (38.3)	22 (13.6)	41.94	**<0.001**	0.509
	11 to 15 years	11 (6.8)	22 (13.6)			
	6 to 10 years	2 (1.2)	16 (9.9)			
	1 to 5 years	6 (3.7)	21 (13.0)			
Membership	Yes	27 (16.3)	33 (20.4)	0.66	0.416	0.077
	No	54 (33.3)	48 (29.6)			
Health Communication	Yes (Not within 12 months)	41 (25.3)	58 (35.8)	6.65	**0.001**	0.215
	No (Never)	40 (24.7)	23 (14.2)			
Health Com (Yes)	Medical	19 (23.46)	23 (28.40)	1.629	0.443	0.135
	Exercise	11 (13.58)	16 (19.75)			
	Both (Medical, Exercise)	6 (7.41)	15 (18.52)			

Factors associated with changes in physical activity levels

Table 13 summarises the results from both unadjusted and adjusted linear regression models examining the factors associated with changes in physical activity levels from pre- to post-migration. The unadjusted models showed significant associations between age, changes in fusion identity, changes in neighbourhood-level forms of social capital specifically social cohesion, social control, and social support, and changes in individual-level neighbourhood attachment with changes in physical activity level. Changes in social support (B = 25.612, R^2 = 0.126), changes in individual-neighbourhood attachment (B= 12.37, R^2= 0.120), and changes in social cohesion (B= 10.85, R^2= 0.116) showed the strongest associations with changes in physical activity levels. While a length of residence in Australia of 11 years or more was significantly associated with a change in physical activity levels, a shorter length of residence in Australia of one to five years was associated with a decrease in physical activity levels. Changes in social control, changes in social leverage, and changes in health communication also showed positive associations with physical activity levels, but to a lesser degree. In contrast, gender and changes in fusion identity exhibited weaker associations with changes in physical activity levels. Gender and health communication were not significantly associated with changes in physical activity levels. Appendix N summarises the results for all variables included in the unadjusted model.

Table 14 summarises the results of the stepwise regression model. Collectively, variables such as age, changes in fusion identity, and changes in social support best explained the changes in physical activity levels from pre- to post-migration (R^2 = 0.225). Significant variables in the unadjusted models which included social cohesion, social control, individual-level neighbourhood attachment, and length of residence post-migration were no longer significant after adjustment. Figure 11 illustrates the estimated marginal means for each independent variable from the adjusted models.

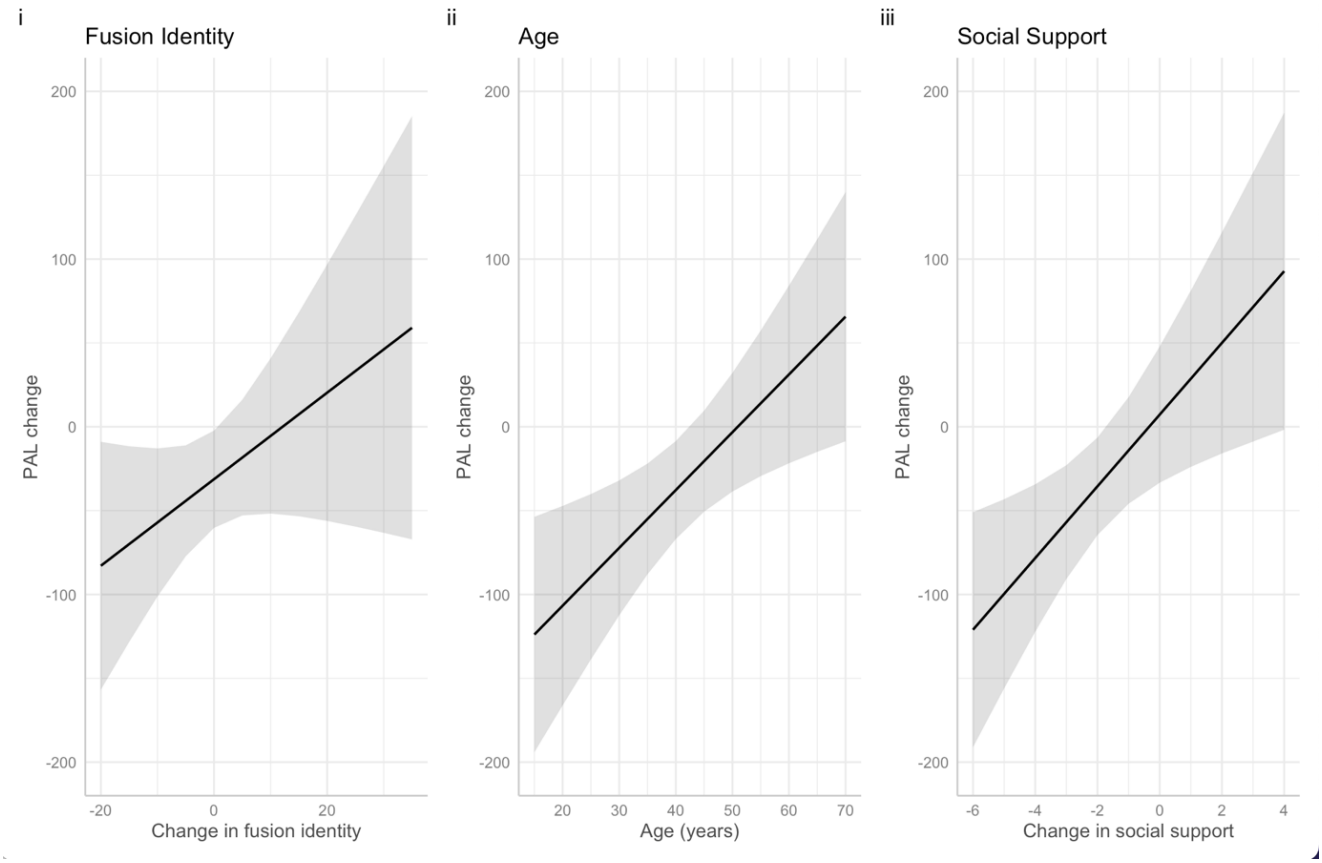
Table 13 *Results of Simple Linear Regression Model with Unadjusted Standardised Coefficients for Change in Physical Activity Levels (n =81)*

	Unstandardised Regression Coefficient	95% Confidence Interval	*p*	R^2
Age	3.50	0.93, 6.07	**0.008**	0.085
Fusion Identity				
Change in total fusion identity	3.66	0.08, 7.23	**0.045**	0.050
Social Cohesion				
Change in social cohesion	10.85	4.15, 17.54	**0.002**	0.116
Social Support				
Change in social support	25.612	10.39, 40.84	**0.001**	0.126
Social Control				
Change in social control	7.35	1.66, 13.04	**0.012**	0.077
Social Leverage				
Change in social leverage	12.59	-16.05, 41.24	0.384	0.010
Individual-level Neighbourhood Attachment				
Change in individual-level neighbourhood attachment	12.37	4.86, 19.87	**0.002**	0.120
Length of Residence (Post)				
15 years or more	101.82	17.66, 185.98	**0.018**	
11 to 15 years	95.07	8.97, 181.17	**0.031**	0.085
6 to 10 years	76.20	-18.30, 170.70	0.112	
1 to 5 years	Empty (-102.18)	-162.35, -42.01	**0.001**	
Gender				
Women	Empty			
Men	-42.00	-106.16, 22.15	0.196	0.021
Neighbourhood Organisation Participation (yes=2, no=1)				
Pre neighbourhood organisation participation (2)	-51.25	-117.76, 15.26	0.129	0.029
Post neighbourhood organisation participation (2)	17.66	-61.70, 97.03	0.659	0.002
Membership				
Pre-membership (yes)	-62.16	-129.38, 5.06	0.069	0.041
Post membership (yes)	74.97	11.29, 138.65	**0.022**	0.065
Health Communication				
Change health communication	49.23	- 1.53, 99.99	0.057	0.045

Table 14 *Results of Adjusted Models with Standardised Coefficients Using Step-Wise Model*

	Unstandardised Coefficient	Adjusted Standardised Coefficient	95% Confidence Interval	*p*	R^2
Age	2.12	0.29	0.09, 0.49	0.006	
Fusion Identity					
Change in Total Fusion Identity	1.89	0.16	- 0.05, 0.37	0.143	0.225
Social Support					
Change in Social Support	21.56	0.30	0.08, 0.51	0.007	

Figure 11 *Estimated Marginal Means Plots*



Note. PAL = physical activity level change. The association between change in PAL and (i) change in fusion identity, (ii) participant age, and (iii) change in social support.

7.4. Discussion

This study provides empirical evidence on diverse sociocultural correlates of overall sport and physical activity from pre- to post-migration among a cohort of Indian migrants living in Australia. Compared to India, participants reported spending less time on physical activity in Australia. In India, most participants engaged in aerobic and team-based activities whereas, in Australia, they engaged in muscle strengthening or a combination of aerobic and muscle-strengthening exercises in individual-based settings. Key factors that best explained the change included change in social support, change in fusion identity, and age. Overall, the results highlight the complex, multifactorial nature of factors associated with physical activity levels among Indian migrants in Australia.

Our findings align with previous studies documenting the low levels of physical activity among Indian migrants in their host countries such as the US (Daniel, Wilbur, Fogg, et al., 2013; Daniel, Wilbur, Marquez, et al., 2013; Jonnalagadda & Diwan, 2005), UK (Hayes et al., 2002) and Australia (Fernandez, Rolley, et al., 2015; Mahajan & Bermingham, 2004). A few studies using objective measures also show less time spent on physical activity among Indian migrants (Daniel, Wilbur, Fogg, et al., 2013; Kolt et al., 2007). However, few studies have examined the *type* of physical activity, which this study addresses. While walking is commonly reported for Indians living in the US (Daniel, Wilbur, Fogg, et al., 2013; Misra et al., 2005), and the UK (Hayes et al., 2002), it is often the only practice examined within studies on Indian migrants in Australia (Fernandez, Rolley, et al., 2015; Mahajan & Bermingham, 2004). For example, a comparison of walking habits only showed Indian women in India spent more time walking than their counterparts in Australia (India: 9.2 ± 9.18 hr/two weeks vs. Australia: 4.8 ± 5.3 hr/two weeks, $p < 0.01$) (Mahajan & Bermingham, 2004). No significant differences were observed in walking habits between Indian men living in India and those living in Australia, which is consistent with this study. However, in this study, gender differences in physical activity were observed, with men showing a 42-minute decrease in physical activity compared to women, though this difference was not statistically significant. This finding aligns with previous studies on Indian migrants in the US (Daniel, Wilbur, Fogg, et al., 2013).

In contrast, among US-based studies examining leisure-time physical activity, one study found about 55% of Indian migrants engaged in aerobic activities, primarily walking, with fewer participating in muscle-strengthening exercises (Jonnalagadda & Diwan, 2005). Another study reported that Indian men participated in a variety of leisure sports, such as cycling, swimming,

hiking, tennis, volleyball, golf, cricket, and basketball, while Indian women preferred activities like cross-country skiing, hiking, and mountain biking (Misra et al., 2005).

If these activities were grouped as they were in this study (see Appendix M), they would support the idea that Indian migrants mainly participated in individual and aerobic-based activities. To validate and expand these findings, future studies could examine the type of sport or physical activity Indians engage in both their country of origin and their host country.

Time spent on physical activity may depend not only on the type of activity but also on the settings in which these activities occur – settings may differ between the country of origin and the host country. Among adults in Australia, seven sports, Australian football, bowls, cricket, golf, hockey, netball, and sailing recorded over 50% of their participation within a sports club or association setting (Eime et al., 2018). In contrast, sports like swimming (9%), basketball (37%), and soccer (38%) were less club-dependent, with substantial participation in informal or non-organised settings. This variation in participation structure is significant, as Indians in India may be more accustomed to informal sport and cultural forms of physical activity practices e.g., yoga, playing outdoor games or engaging in activities in open public spaces (Suraj & Singh, 2011; Vatta et al., 2025), and may therefore face barriers engaging with Australia's more formalised, club-based sport system. In Australia, local governments face challenges meeting the demand for traditional sports such as kabaddi, commonly practised in India but less so in Australia, compared to mainstream sports like Australian rules football (Wyndham City Council, 2022). This discrepancy in the types of sport and physical activity practices between countries could affect engagement in physical activity after migration. Such insights align with the World Health Organization's updated physical activity guidelines (2010 to 2020), which emphasise engaging in a variety of activities (multiple components) such as aerobic exercises, strength training, and balance-promoting activities such as dance, to improve health outcomes (Bull et al., 2020). This is particularly relevant to supporting adults at risk of chronic diseases in meeting the physical activity guidelines (World Health Organization, 2020), as in the case of Indian populations.

Age, change in fusion identity, and change in social support explained 22.5% of the variance in change in physical activity levels from pre- to post-migration. These results corroborate previous ideas that Indians more acculturated to the host culture engaged in more physical activity in their host country (Daniel, Wilbur, Fogg, et al., 2013; Kolt et al., 2007). In this study, each unit increase in social support increased physical activity by 21 minutes while holding age and change in fusion identity constant. This result supports the idea proposed by Thanawala et al. (2020) that, in South Asian populations, the presence of network members who engage in physical activity

(exercise) is linked to higher overall physical activity levels. However, that study involved a broader South Asian population, which limits the ability to extrapolate findings specifically to Indian migrants. Exploring such social network characteristics on overall physical activity and sport participation is encouraged in future research studies on Indian migrants in Australia.

While results from unadjusted associations may demonstrate links between various sociocultural factors and changes in physical activity, on adjustment the disappearance of the association for some variables indicates that some of these relationships, such as those with neighbourhood social capital and health communication, were interdependent, suggesting complex pathways linking these factors to physical activity changes post-migration.

Limitations

This study has several limitations. First, while the sample was intended to represent the Indian migrant population, a smaller-than-expected sample size may have affected the ability to detect certain associations. Voluntary participation, rather than random sampling, could have introduced self-selection bias, with individuals interested in sport and physical activity more likely to participate (Wang & Cheng, 2020). Second, the correlational study, while valuable for initial exploratory research, limits the ability to establish causality. Third, self-report measures present limitations, particularly for recalling pre-migration experiences (Sallis & Saelens, 2000), though these measures proved valuable in achieving the aim of gathering context-based information on pre- and post-migration experiences of sport and physical activity behaviours (Sallis & Saelens, 2000).

Future research

Future research studies could build on this study using similar cross-sectional comparative surveys to examine the associations between migration and the key contextual factors of migrant sport and physical activity participation. Specifically, information on the type of physical activity is important to help medical and allied health professionals tailor advice to meet individual needs (Bull et al., 2020). Studies exploring the role of health advice from professionals could provide a deeper understanding of how health communication influences physical activity levels. Longitudinal studies could clarify the causal relationships between changes in physical activity levels pre- to post-migration and shifts in sociocultural factors, while mixed methods approaches would offer comprehensive insights into how key individual, social, and cultural factors shape pre- and post-migration physical activity and sporting behaviours.

7.5. Conclusions

This study is the first to examine the factors associated with sport and physical activity participation pre- and post-migration. Among a cohort of Indians living in Australia, the factors driving changes in physical activity levels are multifaceted, with social support and age emerging as key predictors. Other factors associated with such changes are neighbourhood forms of social capital, length of residence, and receiving health communication from medical and allied health professionals. The study underscores the significant role of migration, giving importance to wider determinants, specifically pre-migration experiences, when reporting on lower physical activity levels for Indian migrants in Australia. Notable changes in the types of activities engaged in pre- and post-migration could inform the promotion of physical activity in culturally preferred settings for this population in Australia.

CHAPTER 8. FOSTERING EQUITY IN AND THROUGH SPORT: A CONTENT ANALYSIS OF PHYSICAL ACTIVITY AND SPORTS POLICIES FOR MIGRANTS IN AUSTRALIA

Fernandes, S., & Holroyd, E.

Prelude

The previous chapter concluded the exploratory sequential design. This chapter introduces the fourth and final study of the overall project. After identifying the findings from the previous qualitative and quantitative studies, I asked myself, “So what?”, aiming to bridge from what is known to what can be done. This study emerged from my interest in understanding the broader implications, particularly within the context of policy. This led me to explore the policy landscape surrounding sports participation and its role in promoting migrant physical activity. In Australia, this study is the first attempt to review Australian federal, state and local government policy documents prioritising the inclusion and integration of migrants through sport and physical activity. The chapter reports on the current policy landscape across government levels, illuminating the approaches, strategies, challenges and opportunities that exist for promoting physical activity among migrants, particularly Indians. Chapter 8 is written as a manuscript for submission to a peer-reviewed journal.

8.1. Introduction

Physical inactivity is a global health pandemic well-recognised for contributing to the growing economic burden of non-communicable diseases (NCDs) such as heart disease, diabetes, and stroke (Ding et al., 2016). In 2013, physical inactivity incurred global healthcare costs of INT$53.8 billion, with high-income countries bearing most of the healthcare and indirect costs, while low- and middle-income countries faced a greater share of the health impact, including 13.4 million years of healthy life lost and $13.7 billion in lost productivity (Ding et al., 2016). If global levels of physical activity are not increased, it is estimated that the total cost of physical inactivity globally will be approximately INT$520 billion by 2030 (Santos et al., 2023). In 2018, physical inactivity in Australia accounted for 2.5% of the total disease burden, contributing to 20% of the burden from type 2 diabetes and 16% from coronary heart disease (Australian Institute of Health and Welfare, 2021). The recent Australian National Health Survey 2022 showed 78% of Australian adults aged 18 to 64 years were insufficiently active, with women more likely to be inactive than men (80% vs 75%) (Australian Institute of Health and Welfare, 2021).

Migration is also a key contributor to global health equity (Hossin, 2020) and presents additional challenges in physical activity participation. Previous work by Holdsworth et al. (2017) identified the contexts, such as migration, social and cultural settings, health communication, physical environment, and social and material resources, that may influence the physical activity behaviours of ethnic minorities when adapting to new host countries. Migrants may be required to adjust to and/or accommodate new lifestyle behaviours when adapting to host environments compared to their countries of origin, which can exacerbate existing health risks (Bauman et al., 2009). In Australia, the estimated data for 2023 showed an increase in the proportion of the migrant population from 27.7% in 2013 to 30.7% (Australian Bureau of Statistics, 2023). Among the rapid and recent rise in this diverse migrant group, the Indian migrant population has more than doubled, increasing from 1.6% in 2013 to 3.2% in 2023, and now makes up the largest Asian-born migrant group in Australia, surpassing the Chinese community (Australian Bureau of Statistics, 2023). This demographic shift underscores the need for policies and other relevant physical activity initiatives to account for the unique health needs and sociocultural contexts of migrants later in life in their host countries.

Participation in sports and physical activity is not only about addressing health-related lifestyle challenges but also facilitates social integration and promotes healthier living practices (Donnelly & Coakley, 2002; Spaaij, 2013). For Indian migrants, who commonly are at higher risk for NCDs compared to the host population (Arokiasamy, 2018; Fernandez, Everett, et al., 2015), enhancing

physical activity levels is essential to meet Australia's physical activity recommendations and improve health outcomes (Dassanayake et al., 2011; Mahajan & Bermingham, 2004; O'Callaghan et al., 2021). However, facilitating participation in sport and physical activity among migrants may be influenced by the wider contexts. Among Indian migrants in Australia, sociocultural factors such as social connections, cultural practices, and physical environments have been identified as key influences on physical activity participation (Fernandes et al., 2021; Fernandes et al., 2023). Given these influences, we reasoned that sport policies and a broad spectrum of physical activity policies should be examined to determine which documents adequately reflect the engagement of migrants, and address key contextual domains for migrant inclusion and participation in sport.

Therefore, the primary aim of this study was to examine how sport and physical activity documents at the federal, state (Victoria), and local government (LG) levels prioritise the inclusion of migrants and address strategies to promote equitable access and opportunities for their participation in and through sport in Australia. A secondary aim was to compare policy approaches across these government levels, focusing on documents from LGs in the state of Victoria that cover areas with higher concentrations of Indian residents.

In this paper, the term "sport" encompasses both structured and informal physical activities, for example, walking, cycling, and swimming. This reflects the Australian Government's approach that recognises "sport" includes both formal and informal forms of physical activity (Australian Sports Commission, 2018). We considered this broad definition particularly suited to migrants, as it encompasses a range of activities, particularly cultural and recreational pursuits, and differs from traditional Western concepts of sport, and permits an unravelling of the intersections of sport in fostering social connections, improving wellbeing, and promoting fitness.

8.2. Methods

This qualitative documentary analysis describes and interprets official written documents, specifically strategies, action plans, and reports published by Australian federal, Victorian state, and LG entities. The following definitions are adapted from a previous study on sports policies in Europe (Christiansen et al., 2014):

- 'Policy' is defined as a formal written document that has been endorsed by a government body at national (federal), state or local level and includes statements and decisions

defining goals, priorities, and the main directions for attaining goals (Christiansen et al., 2014).

- An 'action plan' refers to a document prepared to support a policy and strategic directions, ideally detailing responsibilities, timelines, resources, and mechanisms for monitoring and evaluation (Christiansen et al., 2014, p. 429).

- 'Strategy' refers mainly to a long-term plan of action designed to achieve the goal of promoting sport; for this article, if both a policy and a related action plan existed, they were unified as one 'strategy' (Christiansen et al., 2014, p. 429).

- Reports: Federal-level reports include research findings, relevant trends on the future of Australian sport, and recommendations on issues such as integration, employment, and settlement outcomes for migrants in Australia. The Australian Government details specific actions in response to support or implement these recommendations. Reports at the LG level track progress and assess how well local initiatives align with broader goals that link to promoting sport and recreation.

For this study, Australia's three-tier government system was defined as follows:

- Federal level: Documents enacted, and/or implemented by the national government at the country-wide *whole population level,* i.e., Australian Federal Government.

- State level: Documents enacted and/or implemented *across a state* by the state government, e.g., Victorian State Government.

- Local level: Documents enacted or implemented by LGs *within a state* at the local community level*,* e.g., BrimBank City Council, Greater Melbourne, State of Victoria.

Design and setting

This study focused on the contexts in which inclusionary aspects of participation for migrants are mentioned, examining how these aspects are framed in the strategies adopted to promote migrant inclusion and participation, and why they are explicitly represented in this way (Wiesner, 2022). To guide the analysis, the study adopted a four-step framework for systematic documentary analysis (Dalglish et al., 2020), previously applied in health policy studies (Emsley

et al., 2022; Hoyle et al., 2024). All documents have been de-identified for reporting and discussing any findings. Saturation was achieved when no new information emerged with sufficient replication of coded text passages to substantiate the study's coding framework (Rahimi & Khatooni, 2024). Ethical approval was not required, as all documents were publicly available and did not require permission from publishers.

Conceptual domains

Holdsworth et al. (2017) identified eight contextual domains with their associated factors as influences on physical activity behaviours of ethnic minority populations living in high-income host countries. They highlighted migration as a distinct domain; other domains included sociocultural settings, health communication, psychosocial contexts, workplace environment, physical environment and opportunity, social and material resources, and political environments. A study on ethnic minority populations in Europe (Sawyer et al., 2024) drew on these domains to emphasise the need for understanding the complex, interconnected individual, social, and environmental factors that influence physical activity, and how some of these relationships can be modified by interventions or policies. Adopting these domains supported the framing of documents to better tailor recommendations that address the unique needs of migrants.

Reflexivity statement

The authors of this study are of Indian heritage (SF) and New Zealand European heritage (EH). Their professional expertise spans public health, medical anthropology, social justice, health equity, sport, and physical activity. They recognise that achieving equity for migrants in Australian sport and physical activity policies requires a deeper exploration of migration shaped by diverse contextual experiences.

Information sources and search strategy

Externally facing documents were sourced from public websites, online portals, and government websites via the Google search engine. Following the application of the inclusion and exclusion criteria set out below, a purposeful selection of documents ensured a sufficient quantity and variety of materials to meet the study's aims (Flick, 2022). Initial keyword searches combined terms related to physical activity and sport along with "migrant" or "culturally and linguistically diverse" (CALD) to identify relevant documents.

To address the secondary aim of focusing on documents from LGs in Victoria covering areas with higher concentrations of Indian migrants, LGs in Greater Melbourne were selected based on data

from the Victorian Government which identified areas with a high concentration of the Indian population (Victorian Government Australia, 2023, 2024). Documents from the top five LGs were handpicked (if not already included from the primary search via Google) for the study. All searches were limited to English-language content focused on Australia. The initial search began in November 2023, with an update of documents in February 2024 and a final check in October 2024.

Eligibility criteria and screening

Eligible documents were:

- Documents with titles specifically focused on sports, recreation, and health sectors, and related to enhancing physical activity. These sectors, both individually and at intersections, can be key settings likely to influence migrants' engagement in physical activity and sports.
- Documents written in English, with the most recent versions published in the past 10 years, specifically from 2014 to 2024.

Excluded documents were:

- Information guides, programs, and research summaries from non-governmental organisations or independent entities such as national, state peak advocacy, and representative bodies for sport and/or active recreation.
- Documents related to children or older adults. The study focused on ages 18 to 64 years, in line with the national physical activity guidelines for adults. Australia has specific guidelines for children and young people between 5 and 17 years, and for older individuals above 65 years (Australian Department of Health and Aged Care, 2021).
- CALD populations not explicitly linked to migrants or migration-related terms were excluded from the coding process.
- Incomplete drafts, and outdated versions.

Data extraction, synthesis, and analysis

Development of the category system (coding framework)

The diverse contextual domains of influence on physical activity presented by Holdsworth et al. (2017) helped frame key categories, including factors related to migration and those related to social and cultural settings, physical environment, health and health communication, and occupational settings. The overall coding framework followed a systematic, rule-driven deductive

category system for a comprehensive document analysis (Mayring, 2014). Additional categories, namely target groups, sectors and institutions, goals, and evaluation, were drawn from a previous study as effective indicators for policies planning and promoting physical activity (Daugbjerg et al., 2009). These indicators included sectors and institutions, target groups, legal status, goals and targets, timeframes, budgets, evaluation, and implementation. For this study, only a few indicators were selected to complement the existing categories and align with the research aims. For instance, including target groups complemented the examination of migrants as specifically targeted within the document. Once categories were identified, categories linked by specific text passages were grouped to form an overall nominal category system for reporting the findings. This system was refined throughout the coding process. Table 15 presents the deductive category system, with definitions, rules, and examples guiding the analysis of categories selected to reflect the documents' content, implementation, and evaluation (Mayring, 2014). A full list of deductive categories included for content analysis is provided in Appendix O.

Unit of analysis and coding rules

The unit of analysis comprised paragraphs and sentences explicitly linked to migrant or migration-related terms in the context of sport. Each document was read in full to identify any other derivatives from migration-related terms. Coded sections and paragraphs with terms such as "overseas" and "birth country" and mentions of regions such as "India" and other migrant countries were considered indicators of migration-related terms.

When formulating the coding rules, text passages on the sectors of sport and physical activity had to explicitly address migrants or migration, even if "sport" was not directly mentioned in the coded text. Similarly, coded passages from immigration or settlement sectors were included only if the text was directly related to sport and/or physical activity. No attempts were made to discern the recency of migration, for example, to distinguish first-generation migrants from second-generation individuals.

Analysis procedures

Prior to analysis, initial authenticity and credibility checks were performed by Author 1 to ensure the selected documents were relevant to the study aims, complete versions, and error-free (Morgan, 2022). A data extraction template in Microsoft Excel complemented this by capturing key details, such as the title, publication information, government level (local, state/territory or federal), document type (e.g., plan, strategy), and publication year. This process enhanced the

overall trustworthiness of the research, ensuring the content was drawn from reliable published sources (Elo et al., 2014).

After reviewing each document in full, Author 1 performed a keyword search using the search functions in PDF and Word documents, targeting terms such as “physical activity,” “exercise,” “sport,” and “recreation” (for non-sporting sectors), and migration-related terms like “overseas,” “India*,” and “migra*” across all documents. This approach ensured the inclusion of migrant-related aspects and their links to sport participation. Thereafter, Author 1 coded a subset of the documents, generating coding rules for any ambiguous text passages to ensure clarity across the selection of texts for each category. Coding rules were documented and referenced throughout the coding process. After coding 30% of the documents, Author 1 revised the categories and coding schemes as necessary until the coding guidelines included sufficient examples to facilitate a smooth coding run-through. Author 2 then independently reviewed the initially coded text passages from the same 30% subset of policy documents and provided written feedback. Both authors collaboratively resolved any discrepancies before finalising the categories, definitions, and coding rules, resulting in a cohesive a priori coding framework (or category system), as outlined in Table 15. Author 1 applied this framework to code the remaining documents. All documents were imported and coded using NVivo 14 for Mac, Version 12, a data management software tool (QSR International Pty Ltd, 2018). Crosstab queries analysed the frequency and distribution (n%) of coded data across different categories, providing insights into how these categories are distributed across government levels. This study used the Standards for Reporting Qualitative Research (SRQR) guidelines (O’Brien et al., 2014), which is provided in Appendix P.

Table 15 *Deductive Category System, Category Definitions, Coding Rules, and General Examples are Scoped Across the Documents*

Category	Category Definitions	Coding Rules	Anchored Examples
TARGET GROUPS	Identified migrant population groups.	For granularity, where possible specify migrant subgroups if mentioned (e.g., refugees, skilled migrants).	"Other target groups included middle-aged men, new migrants, and Indigenous Australians."
MIGRATION CONTEXTS	Examine migration – barriers like discrimination, cultural adaptation and integration challenges.		"The last decade has seen this trend continue with growth in migration to Australia (predominately from the Asia-Pacific region particularly from India, China and New Zealand)."
SOCIAL & CULTURAL	Examine how social and cultural factors support migrant integration and participation, including the role of peer groups, social networks, supportive structures, and cultural requirements.	Code texts on barriers and facilitators that affect participation; use specific examples to illustrate findings.	"These social, environmental, structural, economic, cultural, biomedical, commercial and digital factors lead to inequity and inequality within society. … including the neighbourhood we grew up in."
PHYSICAL ENVIRONMENT & OPPORTUNITY	Explore considerations for the availability of culturally sensitive facilities and improved accessibility.	Note how facilities adapt to meet the needs of diverse communities; emphasise flexibility in design and use.	"The hierarchy of facilities will respond to changing and emerging needs of the local community through flexible design."
SOCIAL & MATERIAL RESOURCES	Explore online social platforms for sport and PA.		"The Department launched an online interface in October 2019 to facilitate bringing the community together and is looking for other opportunities to link humanitarian entrants with the community."
WORKPLACE ENVIRONMENT	Explore occupational settings and workplace policies that support engagement and integration.	Highlight successful examples of integrated economic and social participation.	"Integrated approach to economic and social participation delivers outcomes for young refugees and other vulnerable migrants by improving workplace readiness, providing access to vocational opportunities and creating strong social connections through education and sports engagement."

SECTOR & COLLABORATION	Key partners involved in developing and implementing initiatives.	Collaboration between federal, private sectors, non-government organisations, municipalities, media, associations, employers, etc.	"A place-based approach to delivering [initiative] through an integrated, end-to-end delivery model. [organisation] works with organisations in the broader community to facilitate one-off events or ongoing programs."
IMPLEMENTATION	Assess the clarity of the implementation plan for the policy and the definition of responsibilities for those involved in executing it.		"… is a holistic program designed to improve workplace readiness, provide access to vocational opportunities and create strong social connections through education and sports engagement."
GOALS AND TARGETS	Specified targets for migrants and time periods.		"Priority areas Inclusion Participation Promote environments that are safe and encourage participation and involvement across diverse cohorts, including … migrants."
EVALUATION	Assess the budget allocated for achieving the policy's objectives, including specified financial resources.		"The Framework provides a high-level structural blueprint for Commonwealth, state, territories and local government to work together to effectively plan and deliver services that support the settlement of migrants and new arrivals."

Note. This table is informed by the work described by Mayring (2014).

8.3. Results

Selection and description of retrieved documents

Document selection

The initial search found 31 policy documents on sport and physical activity related to culturally diverse communities and/or migrants or migration in Australia. Thirteen met the study's inclusion criteria. Seven additional hand-searched documents added from reference lists ensured there was a thorough selection across government levels while maintaining the focus on Indian populations at the LG level. Older documents were replaced with recently published versions from 2014 to 2024. Figure 12 illustrates the document selection process and Table 16 outlines the titles and jurisdictions of the included documents.

Figure 12 *Document Selection Process*

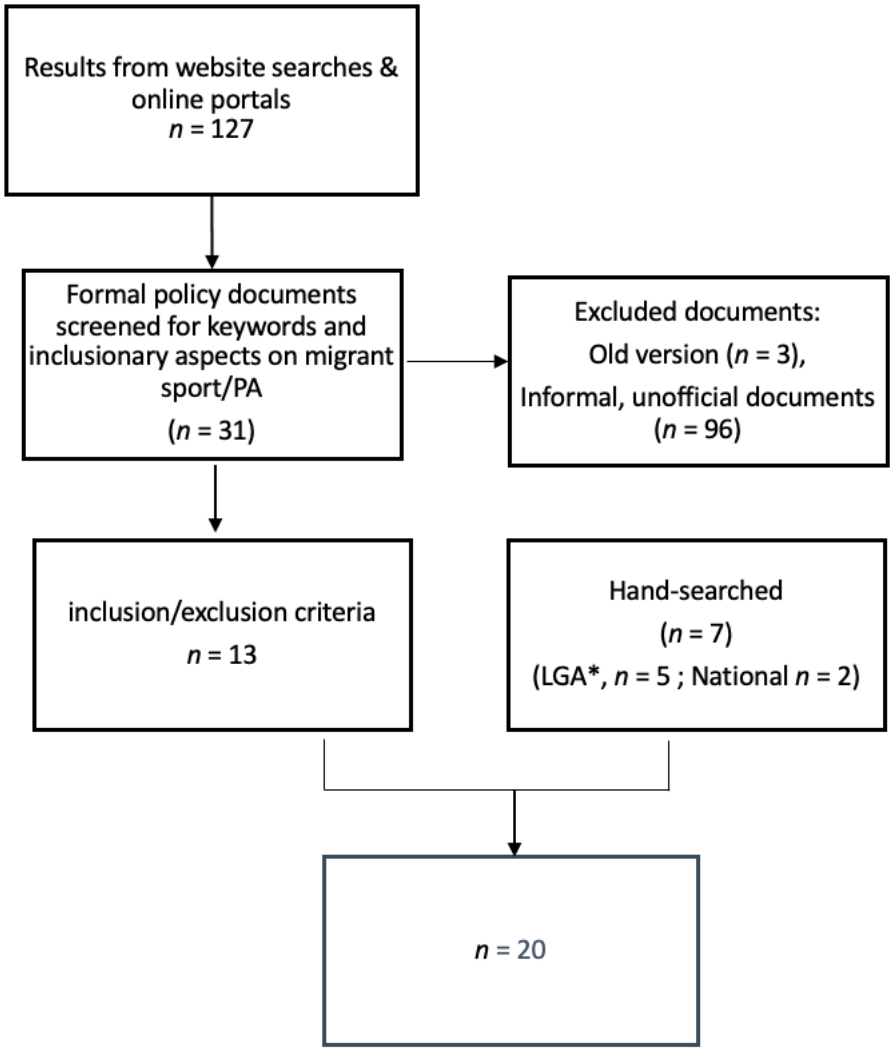


Table 16 *Overview of Policy Documents Included in the Content Analysis (n=20)*

Level	Title and Publication Information	Sector
FEDERAL GOVERNMENT	Sport 2030: National Sport Plan Published 2018, Australian Government, Australian Sports Commission	Sport
	Consultation Phase for the Development of the National Sport Plan Published 2018, Australian Sports Commission, Urbis Pvt Ltd	Sport, Recreation
	National Preventive Health Strategy 2021–2030 Published 2021, Australian Government, Department of Health	Health
	Physical Activity and Exercise Guidelines for all Australians. Website (18 to 64 years) Fact sheet & tips; Make your move – Sit less - Be active for life! Guidelines, 18 to 64 years. Brochure Published 2021, Australian Government, Department of Health and Aged Care	Recreation
	The Future of Australian Sport Second Megatrends Full Report Published 2022, Australian Government, CSIRO	Sport
	National Sports Plan: Public Consultation Paper Published 2023, Australian Government, Department of Health and Aged Care	Sport
	Investing in Refugees: Investing in Australia. The Findings of a Review into Integration, Employment and Settlement Outcomes for Refugees and Humanitarian Entrants in Australia Published 2019, Australian Government, Commonwealth of Australia	Immigration and Citizenship
	Australian Government's Response to Recommendations in the Report: Investing in Refugees, Investing in Australia: The Findings of a Review into Integration, Employment and Settlement Outcomes for Refugees and Humanitarian Entrants in Australia Published 2019, Australian Government, Department of Home Affairs	Immigration and Citizenship
	Australia's High-Performance Sport Strategy – 'Win Well' Published 2022, Australian Government, Australian Sports Commission	Sport
	Sport Horizon: National Sport Strategy 2024 - 2034 Published 2024, Australian Government, Office of Sport	Sport
STATE GOVERNMENT	Victorian Public Health and Wellbeing Plan 2023–2027 Published 2023, Victoria State Government, Department of Health	Health
	Active Victoria 2022-2026 – A Strategic Framework for Sport and Active Recreation in Victoria. Published 2022, Victoria State Government, Department of Jobs, Regions and Precincts	Sport, Recreation
LOCAL GOVERNMENT *	Make Your Move: Greater Dandenong Physical Activity Strategy 2020–2030 Published 2020, Greater Dandenong: Greater Dandenong City Council	Recreation
	Greater Dandenong Physical Activity Strategy 2020-30: Year 3 Implementation Plan (2022-23)	Recreation

Published 2022, Greater Dandenong: Greater Dandenong City Council	
City of Casey Sport and Physical Activity Strategy, 2021-2025	Sport,
Published (Unknown), City of Casey: Casey City Council	Recreation
Active Wyndham	Recreation
Published (Unknown), Wyndham City: Wyndham City Council	
Wyndham Sports Strategy 2045	Sport
Published 2017, Wyndham City: Wyndham City Council	
Wyndham 2040 Community Vision - Progress Report 2023-2024	Recreation
Published 2023/2024, Wyndham City: Wyndham City Council	
Brimbank Physical Activity Strategy	Recreation
Published (Unknown), City of Brimbank: Brimbank City Council	
Active Monash: Monash Active Recreation Opportunities Strategy	Recreation
Published 2021, City of Monash: Monash City Council	

Note. * **=** Documents addressing the secondary aim focusing on Indian migrants at the LG level.

The policy landscape: Cross-government level comparisons

A. Quantitative description of documents analysed

Table 17 summarises the characteristics of the 20 retrieved documents: 10 federal government, two state government, and eight LG documents. Of these, 15 documents containing migration-specific keywords were coded against the predefined categories.

Federal government documents primarily focused on sport. Migration-specific keywords like "Migra*", "Oversea*" and "India" appeared frequently. In contrast, state government documents displayed more balance, addressing both sport and recreation, but were less focused on migration, with few mentions of "India" or migration-specific terms compared to federal government and LG documents. On the other hand, LG documents presented a clear focus on recreation with half mentioning the "Indian" migrant population. However, the overall focus on migration was less pronounced than in federal government documents, which represented more counts on the intersections of migration and sport. This may suggest attention to the inclusion of Indian migrants at both local and federal levels, but federal documents are more likely to consider migration and address the intersection of migration and sport in a more focused or detailed way as reflected across the variety of document types on migration in relation to sport. Appendix Q visually details the prevalence, frequency, and coding references across government levels.

Table 17 *Summary of Documents Focusing on Document Sector, Document Type, Migration-Specific Keywords, and Year, Published by Federal, State and Local Government Level (n=20)*

	Federal (*n* %)	State (*n* %)	Local* (*n* %)
Sector			
Sport	5 (83)	0 (0.0)	1 (17)
Recreation	1 (14)	0 (0.0)	6 (86)
Both (Sport, Recreation)	1 (33)	1 (33)	1 (33)
Health	1 (50)	1 (50)	0 (0.0)
Immigration and Citizenship	2 (100)	0 (0.0)	0 (0.0)
Document Type			
Plan	1 (33)	1 (33)	1 (33)
Consultation Paper	2 (100)	0 (0.0)	0 (0.0)
Strategy	3 (30)	1 (10)	6 (60)
Guideline	1 (100)	0 (0.0)	0 (0.0)
Report	3 (75)	0 (0.0)	1 (25)
Migration-Specific Keywords Mentioned			
Migra*			
Yes	8 (73)	2 (18)	1 (9)
No	2 (22)	0 (0.0)	7 (78)

Oversea*			
Yes	4 (44)	2 (22)	3 (33)
No	6 (55)	0 (0.0)	5 (45)
India			
Yes	2 (50)	0 (0.0)	2 (50)
No	8 (50)	2 (12)	6 (38)
Years			
2017–2020	4 (67)	0 (0.0)	2 (33)
2021–2024	6 (55)	2 (18)	3 (27)

B. Content analysis

The content analysis identified two nominal categories: 1) Social and cultural inclusivity and equity in sport, which comprised categories specifically for the contextual domains related to the social and cultural factors and the intersections with the physical environment, workplace environment, and health communication; and 2) Approaches to promoting policy migrant equity and inclusion, which examined strategies promoting migrant participation in sport, with categories comprising of target groups, goals/priorities, implementation initiatives, sectors and collaboration, and evaluation. The workplace environment overlapped with implementation initiatives, particularly in using sport to foster social connections for migrants while supporting their workplace competencies. Findings related to the health and health communication category were not solely linked to migrants, sport, or physical activity, and are therefore presented in this section for reporting purposes only. Table 18 summarises the nominal category distribution of coding references across predefined categories by government levels. Appendix R details the distribution for all main categories within the deductive coding framework across government levels.

1) Social and cultural inclusivity and equity in sport

Key categories that emerged from the content analysis provide a comprehensive understanding of the contextual domains linked to migrant sport participation, as reflected in the coded documents. These are reported below.

<u>Migrant demographic shifts and rising cultural diversity</u>

Most documents recognised Australia's demographic changes driven by migration but only federal government and LGs highlighted the recent and rapid rise in the number of Asian migrants, particularly Indian migrants. In contrast, state government documents lacked granularity on such information. Three LG documents emphasised a growing culturally diverse population, with a rising proportion of overseas-born residents. For instance, one LG noted, "*the top five countries of birth outside Australia being India, New Zealand, Philippines, England and*

China. … The proportion of residents born in India doubled between 2011 and 2016" [LG ID 17, Sport sector]. Another LG highlighted its status as the "*most culturally diverse locality in Australia with over 64% of its population born overseas, and residents from 157 different birthplaces. … [Birthplaces] included Vietnam, Cambodia, China, India, Sri Lanka, Pakistan, Afghanistan, New Zealand and Great Britain"* [LG ID 13, Recreation sector]. These quotes highlight the significant increase in the number of Asian residents, particularly those who are Indian-born. While LGs focused on the growing cultural diversity, federal government documents complemented and expanded the view on the influx of migrants (including Indians), referencing long-term trends and projections that Australia's population growth would increasingly come from overseas migration, particularly from Asia. As a federal government report stated:

> *"By 2060, 74% of Australia's population growth is expected to come from overseas migration … the last decade has seen this trend continue with growth in migration to Australia (predominately from the Asia-Pacific region and particularly from India, China, and New Zealand)." [Federal ID 5, Sports sector]*

Role of sport

In the context of current and anticipated demographic shifts from migration, the role of sport emerged across both federal government and LG documents as a means of fostering integration and social cohesion. Federal government documents positioned sport in a broader, societal context, while LG documents focused on the need to accommodate preferences and participation formats to engage new migrants in sporting activities. The following quotes illustrate this view:

> *"Sports can bridge the gaps between diverse communities … sport's role in introducing newcomers to local communities, assisting people in making friends, establishing social networks, gaining a sense of belonging and staying physically active [as well as] help[ing] young migrants increase their confidence and self-esteem in a new society." [Federal ID 5, Sport sector]*

> *"The continual growth and development of [LG's] diverse community brings new sports and new ways to engage newly arrived communities from south and southeast Asia, Africa and the Middle East are seeking different sports and changes to existing formats of participation." [LG 17, Sports sector]*

Building community connections through sport

In integrating migrants, federal government documents emphasised the importance of building migrant social networks, whereas LG documents focus on informal, team-based sports that bring diverse nationalities together to support migrant integration. The following excerpts illustrate this:

> *"On Friday nights, a group of Colombian men play against Chileans. Both groups wear homemade team jerseys. On Sunday afternoons in summer the informal Sydney*

> *Nepalese [Name] Soccer Club uses the park to train. Later in the evening, men from Nepal and India play social cricket. These games have histories. Many of the players have gathered weekly for years. In some cases, informal teams have evolved into official leagues." [LG ID 13, Recreation sector]*
>
> *"They build on connections at the shopping mall, in the workplace, by participating in community programs or joining in sporting activities. Some begin by volunteering and assisting in their own communities but, in doing so, they build relationships with the wider society." [Federal ID 7, Immigration sector report]*

Migrant engagement in e-sport, digital platforms and community integration

Federal government and LG sport sector documents highlighted the growing popularity of e-sports and virtual physical activity; however, their relevance to migrant populations was unclear. Conversely, the immigration sector report of a review into integration, employment and settlement outcomes for refugees and humanitarian entrants in Australia proposed that digital platforms may allow migrants to connect directly with volunteer services offering practical support. This document states:

> *"The Commonwealth Government can help this [existing volunteer initiatives] process of connection by funding the development of a digital platform to help refugees connect directly with volunteers who are offering assistance and practical support. [Example mentioned were] … offering study support, … transport assistance, and shopping excursions." [Federal ID 7, Immigration sector report]*

In response, the Australian Government supported such digital platforms aimed at integrating migrants into the community. The supporting excerpt stated: "*The Department launched an online interface in October 2019 to facilitate bringing the community together and is looking for other opportunities to link humanitarian entrants with the community"* [Federal ID 8, Government response to immigration sector report].

Physical environment and promotion of opportunities

LG- and state-level documents both emphasised the importance of sports facilities and open spaces in encouraging physical activity and supporting community integration, but they differed in scope, focus, and the specific needs they addressed. LGs took a tailored approach to adapt/introduce new formats for traditional sports, such as cricket, to engage the South Asian community with a social focus. Further considerations included no-fee settings, informal social sports, and culturally relevant activities to foster inclusion. Within these informal, no-fee settings, the LG documents recognised the growing popularity of culturally traditional sports: For instance, kabaddi, a traditional Indian sport, is gaining traction. To support these evolving community needs, LG documents emphasised the need for flexible sports facilities that could host multiple sports at the same venue. The following excerpt illustrates these ideas:

> *"Culturally traditional sports including Sepak Takraw are being played in no-fee settings with more people developing interest and participating, whilst Bocce has moved away from a designated competition venue to a social group that travels outside of [LG area] to play. Sports including kabaddi and pencak silat are beginning to develop and seek places to play. … Organised sports including club-based sports are the preferred model for participation in 15 sports including archery, Australian rules football, basketball, cricket … [a]lthough the recent influence of the South Asian migration has seen the development of a social cricket competition in a 50-week format. … The hierarchy of facilities will respond to the changing and emerging needs of the local community through flexible design where one, two or three different sports may operate from the same facility." [LG ID 17, Sport sector]*

While LG documents focused on culturally specific sports, state-level documents took a broader approach, emphasising the overall availability of accessible, high-quality sports facilities. They highlighted the importance of ensuring that areas experiencing population growth – particularly urban and rural regions – have access to spaces that promote physical activity and community integration. While some regions are well-equipped with sports infrastructure, others face challenges due to limited resources.

> *"Active environments Accessible, high-quality places and spaces can increase population-wide physical activity levels. The availability of open space, and the development of high-quality sport and active recreation infrastructure, is highly variable. Regional and rural Victoria often has different requirements, due to the unique characteristics of these locations. Several factors affect environments for sport and active recreation including population growth, urbanisation, climate change, bushfires, classification of open space, and changes in population demographics."* [State ID 12, Sport and recreation sector]

<u>Cultural determinants of health</u>

Overall, the documents focus on cultural determinants and health but they do not explicitly reflect the potential role of sport and physical activity in improving the health outcomes of migrant populations. One national strategy referenced trained health professionals providing advice on physical activity, but the connection to migrants was unclear. For example, this health sector document aimed at increasing physical activity levels across the national population by 2030 and proposed: "*Healthcare professionals are trained and supported to provide advice and support to patients to promote physical activity and engage in social prescribing (connecting patients with community services to improve health and wellbeing*)" [Federal ID 3, Health sector]. There is a missed opportunity to explicitly address how culture and migration might intersect with sporting practices or how sport could be used as a tool for health promotion among these groups.

<u>Workplace environment</u>

One federal government document highlights the use of sport as a means to support the integration of migrants, particularly youth in a program intended to facilitate their transition to

work, and in developing other relevant opportunities. As the document stated: *"[Name of service – a program – is] designed to improve workplace readiness, provide access to vocational opportunities and create strong social connections through education and sports engagement*" [Federal ID 7 Immigration sector]. The document mentioned that the success of this approach is attributed to its integrated strategies and the collaborative partnerships between national departments and local agencies.

> *"As a successful example of a more integrated approach to economic and social participation. They deliver outcomes for young refugees and other vulnerable migrants by improving workplace readiness, providing access to vocational opportunities and creating strong social connections through education and sports engagement." [Federal ID 7, Immigration sector]*

2) Approaches to promoting migrant equity and inclusion

The documents reviewed mentioned few direct efforts or planned initiatives to promote the inclusion and participation of migrants in sport. These references were mostly found in a few federal-government-level documents, with no information available from state-level documents. None provided details on budget, timeframes, or legal compliance concerning migrants' participation in sport. It was apparent that few strategies aimed at promoting migrant inclusion and equity explicitly identified migrants (sport sector) and new migrants (immigration sector) as target groups. Other strategies involved integrated initiatives with sport as a component, forming collaborative partnerships and adopting an existing framework that provides a general structural plan for different levels of government to collaborate effectively in the planning, evaluation, and implementation of migrant-focused strategies and initiatives. These are outlined below.

<u>Target groups</u>

Federal-government-level documents explicitly identify migrants as a key target group in efforts to promote inclusion and participation in sport across diverse populations. Notably, two sport-sector documents explicitly distinguished between "*migrants and culturally and linguistically diverse"* [Federal ID 2, via the National Sports plan; Federal ID 9, via the National Sports strategy]. This highlights migrants being distinguished as separate target groups to the broader CALD in prioritising areas of inclusion. One national sport-sector consultation paper suggested targeting new migrants, but this detail was not explicitly reflected in the recently adopted sport strategies. This consultation paper highlighted that *"participants suggested a number of target groups who they believed could benefit from a targeted campaign to emphasise the positive benefits of physical activity … [which] included middle-aged men, new migrants and Indigenous Australians*" [Federal ID 2, Sport strategy]. By contrast, two documents from the immigration sector refined the characteristics of their target migrant group, specifying them as "*new arrivals*" [Federal ID 8,

Government response to immigration sector report] or "*newcomers*" [Federal ID 7, Report immigration sector], and also focused on initiatives to target the youth. The following quote outlines the immigration sector's planned integrated initiatives tied to the workplace environment using sport to support both employment and social integration:

> "*[Name of service] provides intensive, pre-employment support for young people aged 15 to 21*; … *These [services/initiatives] deliver outcomes for young refugees and other vulnerable migrants by improving workplace readiness, providing access to vocational opportunities and creating strong social connections through education and sports engagement*." *[Federal ID 7, Immigration sector report]*

> *"Migrants and refugees are a priority cohort under this fund and several projects have a specific focus on migrants and refugees, young people and women." [Federal ID 8, Government response to immigration sector report]*

Local workshops and national collaborations

National-level immigration documents highlighted the importance of forming collaborative partnerships between government departments and local community services. Such integrated and collaborative approaches were actively supported by the federal government, leading to positive outcomes for migrant social inclusion and participation in and through sport. On the other hand, an LG progress report focused more specifically on the delivery of cultural awareness training for local sports clubs and anti-racism workshops. The passages below illustrate such efforts at the federal and LG levels in supporting migration inclusion using sport:

> *"[Efforts to support] other migrants to successfully settle in Australia … are already supported through a range of initiatives [considering] sporting groups with refugees and settlement support agencies at a local level. This is already fostering immediate connections between refugees and the communities they live in and is enabling communities to get more involved in supporting successful settlement outcomes. For example, some local businesses have offered employment and volunteering opportunities to refugees, community members are hosting English language conversations in the park, and football clubs are supporting local refugees to join pre-season training with the support of a buddy, free membership and access to equipment." [Federal ID 8, Government response to immigration sector report]*

> *"An Inclusion and Diversity Training workshop for local sports clubs was held to build cultural awareness and inclusivity, as well as anti-racism workshops focusing on the impact of racism in our community and how to find allies, speak up and stand up". [LG ID 18, Recreation sector progress report]*

Planning and evaluation framework

Only one federal-level document mentioned the adoption of a migrant-focused framework that guided the planning and decision-making on supporting migrant participation and integration. A closer review shows sport mentioned as an integrated component in this overall framework. The excerpt below summarises the use of a migrant-focused framework in planning initiatives,

"The existing [Name] Framework already provides a high-level structural blueprint for Commonwealth, state, territories and local government to work together to effectively plan and deliver services that support the settlement of migrants and new arrivals in Australia (including refugees and asylum seekers). It provides a guide how to best make planning decisions on the provision of settlement and support services. It promotes the delivery of coordinated services, informed by research and evaluation. … In our view, it is adequate. We don't need another framework. Rather we need to find a way to make the existing framework perform better." [Federal ID 7, Immigration sector report].

Table 18 *Nominal Category Distribution of Coding References Across Predefined Categories Across Government Levels (n%)*

Nominal Category	Key Category	Federal	State	Local	**Total (*n*=15)**
Policy Implementation & Evaluation	Target Groups	12 (100)	0 (0.0)	0 (0.0)	12
	Goals/Priorities	14 (87.5)	0 (0.0)	2 (12.5)	16
	Implementation Initiatives	4 (80.0)	0 (0.0)	1 (20.0)	5
	Sector & Collaboration	3 (100)	0 (0.0)	0 (0.0)	3
	Evaluation	2 (100)	0 (0.0)	0 (0.0)	2
Social and Cultural Inclusivity and Equity in Sport	Migration & Demographic Shifts	15 (48.4)	2 (6.5)	14 (45.1)	31
	Social & Cultural Contexts	9 (90.0)	0 (0.0)	1 (10.0)	10
	Social & material Resources	12 (85.7)	0 (0.0)	2 (14.3)	14
	Workplace Environment	3 (100)	0 (0.0)	0 (0.0)	3
	Physical Environment & Opportunity	0 (0.0)	2 (20.0)	8 (80.0)	10
	Health & Health Communication	7 (100)	0 (0.0)	0 (0.0)	7
Total	**Counts** (No. of Documents)	9 (60.0)	1 (6.7)	5 (33.3)	16 (100)
	Coding References	91 (74.0)	4 (3.2)	29 (23.4)	124 (100)

Note. Shaded distribution and intensity interpretation: Dark shade indicates high intensity or frequency, i.e., more documents & references coded to the category. Light colour indicates lower frequency (fewer documents coded to that category).

8.4. Discussion

This study is the first to examine how federal government, Victorian State Government and LG policy documents in Australia prioritise the inclusion of migrants and promote equitable access to sport and physical activity. The focus on the state of Victoria is relevant due to its growing Indian diaspora, now the largest ethnic migrant group in Australia after those from England (Australian Bureau of Statistics, 2023). The rising migrant population underscores the need to examine whether sport and physical activity policies effectively promote inclusive and equitable opportunities for migrants in Australian sports settings.

This study found that most federal government and LG documents acknowledged the demographic shifts driven by migration, with sociocultural contexts emerging as a dominant focus. Few LGs in areas with high South Asian/Indian populations considered no-fee settings and informal team-based sports to better service the social and sporting preferences of migrants. Federal government documents included more strategies for effective migrant participation through, for example, specific target groups, collaborative partnerships, and evaluation, while state-government-level policies lacked these aspects. This suggests that migrant inclusion in sport is gaining attention but remains insufficiently addressed in the state-level documents. The limited strategies for promoting migrant inclusion raise questions about whether sport is effectively positioned to support migrant integration, with considerations to better reflect and facilitate migrant inclusion discussed below.

Contextual background

The policy documents in this study generally acknowledge the diverse Australian migrant community as both a challenge and an opportunity for promoting migrant equity and inclusion in sport. Documents, particularly from the sports sector, highlight the role of sport in building migrant social capital. Sport can unite and divide; it has the potential to bring people from different cultural backgrounds together, fostering both integration (the process of migrants becoming part of the larger society) and multiculturalism (celebrating cultural diversity within a society); but it can also create barriers due to cultural differences or socio-economic disparities, which may prevent migrants from fully accessing opportunities for sport and physical activity participation and integrating into society (Hatzigeorgiadis et al., 2013). Furthermore, ethnically homogenous sporting environments can fuel hostility between cultures, limiting integration efforts via sport (Smith et al., 2019). The need to develop environments that facilitate the integrative role of sport for migrants has been highlighted (Hatzigeorgiadis et al., 2013), and identifying what factors shape the integration of migrants in sport (Smith et al., 2019) remains an area for future research among migrants in Australia.

This study reveals how sport as a social practice may be shaped by different contexts and environments. Few documents acknowledged how different migrant groups bring unique sporting traditions (e.g., cricket for South Asians, Sepak Takraw for Southeast Asians) that differ from the mainstream Australian sporting culture. Social aspects, like connecting individuals from diverse cultural backgrounds, have required these traditional practices to be maintained, whether they are games in local parks, informal team sports, or social sporting games (Peters, 2010; Wise et al., 2018, April 30), also mentioned in this study. LG documents from Victoria, for example, reflect a shift towards accommodating culturally specific sports (e.g., kabaddi, social

cricket leagues), demonstrating how policy and physical environments intersect with the social and cultural contexts of sport. The policy outline can either support or hinder this intersection in facilitating the inclusion of ideas of migrant integration in the broader sporting landscape (Spracklen et al., 2015). The aforementioned social practice of sport is not straightforward for Australia. Beyond identifying factors that shape migrant inclusion, it is important to understand how these factors intersect within the CALD population, which has distinct cultural preferences (Smith et al., 2019). Informal social sport, in particular, may have broad social and cultural implications, yielding both positive and negative impacts (Neal et al., 2024). Neal et al. (2024) emphasise how the physical environment – spaces for informal sports – can either foster inclusivity or reinforce cultural divides, affecting migrant integration. Their work explores how agency, belonging, and urban practices intersect with race, ethnicity, class, gender, and age in informal sporting contexts. Further research is needed to understand how informal sport influences migrant lives, particularly in terms of social inclusion and exclusion in urban settings.

Approaches to promoting migrant equity and inclusion

Despite recognising the importance of migrant inclusion, most documents under-represented the strategies implemented or planned to promote migrant sport participation. Federal-level documents mostly represented target groups, collaborative partnerships, and evaluation while such inclusion in state-level policies were notably lacking. This suggests that migrant inclusion in sport is gaining attention but may be underdeveloped or insufficiently addressed at the state level.

Effective policymaking requires a clear and structured plan for implementing sport and physical activity objectives (Daugbjerg et al., 2009). Identifying migrants as a distinct target group, and further identifying them by ethnicity, could limit disparities and avoid fragmented approaches towards planning, implementing, and promoting their participation and inclusion in sport. The limited focus on explicitly targeting migrants may stem from grouping migrants under the broad CALD category of ethnic grouping in Australia (Pham et al., 2021) which oversimplifies the challenges faced by various migrant communities, including newly arrived migrants. While this grouping identifies a culturally diverse and migrant-inclusive Australian population, it fails to differentiate the distinct challenges faced by various migrant communities such as newly arrived migrants. As a result, migrant groups, particularly those facing immediate challenges related to relocation, work, and housing, may experience widening gaps in their opportunities to access and participate in sports. In this study, only one recent sport policy document published in 2024 and the supporting consultation paper in 2023 differentiated migrants from the broader CALD group, though the specific migrant groups targeted remained unspecified. Recognising these

distinctions could lead to more tailored approaches to address the unique challenges faced by migrants in, for example, gender and generational preferences in accessing sports and physical activity (Lane et al., 2021; McGovern, 2024).

While federal sport sector documents could target newly arrived migrants, other migrants, particularly those experiencing challenges in accessing and engaging in sports and physical activity after migration, could be considered. For example, a content analysis of physical activity policy documents from Denmark, Finland, Romania and England targeted subgroups based on life stages (working age, children, aging population), ethnic groups, place-based participation sites like sports clubs, sports volunteers, immigrants and ethnic minority populations (Hämäläinen et al., 2015). In contrast, the documents reviewed in this study lack this granularity. The Australian Government has emphasised targeting migrant subgroups to promote equity and access to its multicultural community (Australian Government, 2018). For example, Australia's multicultural access and policy guide identifies subgroups that government departments and agencies could consider, such as visibly dominant migrants, and those from collectivist backgrounds, as potential subgroups to target. Visibly dominant migrant groups, such as Indians, who present low levels of physical activity, could be a priority group, particularly in Victoria and among the LGs included in this study. Similarly, migrant subgroups from collectivist cultures may face different social norms in Australia's individualistic society (Sava et al., 2024), and could be prioritised in national sports policies to better represent them at the broader, whole-of-population level.

The limited use of migrant-focused frameworks may explain the limited strategies planned or implemented to support migrant participation. This study found that immigration sector documents reflected a proactive cross-sector approach to better including migrant communities. These efforts benefited from adopting a migrant-focused framework for planning and evaluation (Australian Department of Home Affairs, 2016), which the sport sector documents currently lack. Adopting a migrant-focused framework or checklist could be a critical starting point for improving the integration of migrant communities into sports initiatives.

Intersectional lens for promoting sport participation

With the secondary aim of this study focusing on LGs in the state of Victoria with large Indian populations, this study highlights how LGs in areas with high South Asian/Indian populations adapt the physical environment to cater to the sporting preferences of migrants. Such ideas align with previous studies highlighting the need to adapt sport facilities to accommodate the cultural

needs and preferences of migrants in Australia (Fernandes et al., 2023; Smith et al., 2019). This section considers why this matters.

Despite access to sporting and outdoor physical activity facilities, individuals living in socially isolated communities are at a higher risk of inactivity (Josey & Moore, 2018). For ethnic migrants, participation in physical activity often depends on their perception of the social settings (Halbert et al., 2014). Indian migrants, both globally and in Australia, face barriers to physical activity participation due to the perceived lack of social connection and low social support (Daniel et al., 2018; Fernandes et al., 2023; Gupta et al., 2017; Horne & Tierney, 2012; Sawrikar & Muir, 2010). As previously discussed for Indian migrants in Melbourne, applying an intersectional lens to both social factors and physical environments may support their participation (Fernandes et al., 2023). Other authors encourage the use of the intersectional lens in sport and physical activity for the social integration of culturally and linguistically diverse migrant populations in Australia (Smith et al., 2019). The benefits of overlapping factors such as ethnicity, social dynamics, and migration history could extend to first-generation migrants. For instance, first-generation Indian migrants in the UK often view parks as spaces only children use, while second-generation migrants consider parks as place to engage in physical activity and sites to socialise (Bhatnagar et al., 2021), highlighting the need for outdoor spaces that reflect and meet the sociocultural needs of migrants (Aquino et al., 2022; Horolets et al., 2021; Peters, 2010).

Recommendations

Recommendations for federal government

Policymakers could refer to the Australian Government multicultural access and equity policy guide (Australian Government, 2018) for practical strategies aimed at governments and related agencies to undertake, including identifying target groups and key aspects of groups (leadership, engagement, performance, capability, responsiveness and openness) in the planning and delivery of services in Australia's multicultural society. Such information can be relevant to tailoring policies that promote equity and access in sport, ensuring that the needs of migrants are met alongside those of the broader Australian population. The national sport sector could also collaborate with the immigration and health sectors, leveraging local sports clubs and community-based programs to broaden its reach to migrants via settlement initiatives. Co-design with migrants carrying lived experience and involving migrants in diverse roles in the sports sector could help (Mickelsson, 2024).

To better serve the integration of migrants into sports initiatives, a multilevel approach/framework could also be useful. In particular, a bottom-up model (Shahi, 2024), where sports policies are shaped by frameworks developed at the ground level (e.g., in sports clubs – organised or recreational – and local communities), could allow for a more community-driven practical approach (Ehnold et al., 2024). For instance, a proposed multilevel framework, serving as an overarching analytical tool for sport programs, could enhance migrant integration efforts into sport clubs by addressing three different levels: macro (policy), meso (club), and micro (individual migrant population/member) (Ehnold et al., 2024). This approach is one way to ensure that policies are practical and relevant in meeting the needs of the communities they aim to serve, and it is particularly useful at (though not limited to) the local council level, where homogenous migrant groups may exist.

Recommendations for LGs in the state of Victoria with high Indian populations

To promote inclusion and equity for Indians in Victoria, the state government and LGs in areas with high Indian populations should develop an approach for inclusion/expansion on flexible sports facilities. This should incorporate traditional sports within outdoor social sport formats and multisport facilities, as well as accommodating (social) fee structures like pay-as-you-go options or migrant "come and try" days. Policies that effectively integrate social factors with physical environments require evidence-based research to identify and understand the key contextual drivers of Indian migrants' participation in sport/physical activity in Australia. These efforts should be complemented by a well-defined and effective state-level sports and physical activity policy for migrants, which is crucial, particularly to address the low physical activity levels of the growing Indian population in Victoria. This may support the uptake of physical activity for the Indian migrant population, thereby mitigating their risk of NCDs and improving health outcomes. As previously argued, policies promoting exercise, creating healthier environments, or encouraging lifestyle changes, can ultimately contribute to meeting global health goals by 2030 (Santos et al., 2023).

Strengths and limitations

This study is the first to examine how Australian sport policy documents across various tiers of government address issues that concern migrant populations. Documentary analysis proved to be an unobtrusive and cost-effective approach (Morgan, 2022). Content analysis was an effective research method for analysing government policies, with practical applications in formal research settings (Cardno, 2018) and a deductive category system ensured categories and coding aligned with the research aims, providing face validity for the coding framework (Mayring, 2014).

Limitations arise from solely relying on documents from LGs in greater Melbourne in Victoria with a high population of Indians, which limits the inclusion of documents where (re)settlement of Indian communities has taken place and potentially under-represents other LG documents from regional areas of Melbourne. Despite employing a variety of search strategies, some documents may have been overlooked. Member checks were used, and the analysis focused on the manifest content of the texts. The manifest level may not fully capture underlying motives, values, or ideologies related to migrants within the documents, and relying exclusively on content introduces the risk of biases inherent in public records. Overlaps between the health and sports sectors challenge the ability to draw actionable conclusions and make it difficult to isolate the impact of factors specific to each sector. Therefore, the study's findings are based solely on the documents analysed and should be interpreted in light of these limitations.

8.5. Conclusion

This study provides evidence on the landscape of government documents on policies for sport and physical activity (recreation) in Australia from 2014 to 2024, with a specific focus on migrants and documents that highlight migrant inclusiveness. While government documents recognise the role of sport and physical activity in migrant integration, there is an uneven distribution of attention across different levels of government. The findings reveal the need for enhanced intergovernmental collaboration between state government and LGs, improved granularity of detail regarding migrant target groups, and stronger mechanisms to evaluate policy impact. The findings encourage intersectional approaches to equity in sport for migrants, underscoring the need for increased advocacy and political leadership with the rising migrant population, particularly the Indian and other migrant populations in Victoria, where there is an urgent need for a more comprehensive state-level sport policy targeting migrants. These findings highlight the need for integrated approaches and the involvement of migrants in the co-design of initiatives that address their specific needs and challenges, to effectively promote healthier behaviours within this population.

CHAPTER 9. CONCLUSION AND RECOMMENDATIONS

9.1. Summary of research

This thesis addresses the research question "How do key contextual factors relate to experiences of physical activity and sedentary behaviour among Indian migrants living in Australia?" This chapter summarises the key findings from four stages of a multistage mixed-methods research framework (Fetters et al., 2013). Using this framework, the study is the first to apply an exploratory sequential design to research focused on physical activity and sedentary behaviour among Indian migrants. Also, for Indian migrants in Australia, the policy component has explored the policy landscape and positions the narrative within a migrant-focused policy context for Australian sport and physical activity. Findings from the exploratory sequential component described in Chapters 4–7, and the policy component in Chapter 8, triangulate the study's findings. These insights inform research and policy recommendations to promote equitable access and opportunities for Indian migrants' participation in sport and physical activity in Australia. This integrated approach offers both strengths and challenges, which are discussed further in this chapter. The chapter concludes with novel contributions to empirical knowledge, making policy recommendations and offering suggestions for future exploration.

Introductory Chapters 1 - 3 provide the background to the research. Chapter 1 introduced the rationale, research sub-questions, and the positionality of the team members. Chapter 2 presented an integrative review of empirical qualitative and quantitative studies. The chapter highlighted key gaps in the evidence while supporting the knowledge base for undertaking the mixed-methods research study. It outlined a range of contextual influences (Holdsworth et al., 2017) deemed appropriate as a framework to guide the research. Chapter 3 described the philosophical underpinnings and positions of the Indian philosophical lens (Bhawuk, 2010; Ghosh, 2019) and the pragmatic worldview relevant to this mixed-methods research (Feilzer, 2010).

Chapters 4 - 8 reported on the four studies staged independently. Study One described the qualitative phase addressing the following question: *What are the perspectives on physical activity and sedentary behaviour, and what key contextual factors influence participation in physical activity and sedentary behaviour among Indian migrants residing in Australia*? Inductive thematic insights from semi-structured interviews with 21 Indian migrants in Melbourne

revealed key themes related to their perspectives on physical activity and sedentary behaviour and the contextual influences on participating in these behaviours.

Chapter 4 described the work which sought *to identify how Indian migrants living in Australia define physical activity and sedentary behaviour, and how these perspectives are shaped by cultural background and migration.* Participants defined physical activity by viewing it holistically, interweaving mind-body connections, and social, cultural, and environmental factors. Sedentary behaviour was broadly defined and shaped by ideas of purpose and duration.

Chapter 5 reported research which specifically aimed to *explore the range of contextual factors that influenced physical activity and sedentary behaviour among Indian migrants living in Australia*. Comparing experiences in India and Australia primarily reveals how migrants' social, cultural, and physical environments influenced physical activity behaviours, and how occupational contexts (such as the nature of jobs) influenced sedentary practices. This cohort of Indian migrants felt that social connections with family, friends, and the wider community, particularly in neighbourhoods, were stronger in India, and they also perceived Australia's physical and built environment features to facilitate physical activity participation. However, they considered the nature of work, with long hours spent sitting in workplace environments, prompted sedentary lifestyles in Australia. The role of sport was noted, raising concerns about the lack of integration efforts to connect communities of migrants in Australia. Additionally, changes in activities of daily living that arose with migration, such as shifts from walking to driving and the impact of health communication from Australian practitioners, were also reported by these participants.

Qualitative Study One explored the diverse contextual influences and revealed that the participants mostly spoke of contextual influences related to physical activity and sport participation. There were limited references made to sedentary behaviour, primarily in the occupation context. These qualitative insights informed the focus of the remaining studies to a deeper exploration of sport participation and its role in promoting physical activity, under the call to action "Sport and recreation for all" (Milton et al., 2021, p. 626). Consequently, the subsequent studies that follow focus on physical activity and sport participation, with sedentary behaviour limited to the occupational environment.

Chapter 6 described the integration of the thematic insights from Study One in the development of a pre- to post-migration comparison of key constructs related to sociocultural contexts, neighbourhood forms of social capital, health communication, and physical activity participation

levels, along with demographic and cultural factors for example occupational status and Indian cultural background. To building on these themes, Study Two identified the *key constructs, scales, and items representing the qualitative data to refine and adapt a culturally appropriate questionnaire and test its face validity.* The study sought to engage both research and cultural experts to gather feedback and reach consensus on questionnaire design and contextual issues using a three-round modified Delphi technique. Ultimately, Study Two provided insights into adapting and pretesting a culturally appropriate questionnaire to measure key sociocultural factors influencing physical activity including sports participation, addressing the lack of context-specific measures for Indian migrants. This pretested instrument formed the basis for the subsequent quantitative inquiry in the third study.

Chapter 7 outlines a cross-sectional data with a sample of 81 Indian migrants to measure *the association between sociocultural factors and overall sport and physical activity levels among Indian migrants living in Australia, pre- and post-migration.* Computing a paired t-test and chi-squared test of independence determined changes in physical activity levels and types of activities and participation settings from pre- to post-migration, while regression models identified the significant sociocultural factors associated with changes in physical activity levels from pre- to post-migration. Results showed a significant decrease in physical activity levels post-migration. Statistically significant differences (chi-squared test of independence) were observed in activity types (e.g., aerobic, muscle strengthening) and participation settings (e.g., team, individual, cultural). Age, change in social support, and fusion identity accounted for 22.5% of the variance in physical activity levels from pre- to post-migration (stepwise regression). As the first study to explore these sociocultural correlates for Indian migrants in Australia, the findings confirm that both individual factors (e.g., age) and contextual factors (e.g., social support, neighbourhood dynamics) influence Indian migrant physical activity participation.

The final study described in Chapter 8 presents *the contextual landscape of sport and physical activity policies in Australia.* The study compares how, *in promoting equitable access and opportunities for migrant participation in and through sport and physical activity*, federal government, state government and LG policy documents positioned migrant participation in sport, with a focus on Indian migrant populations at the Victorian state and LG levels. Deductive content analysis of 20 policy documents (federal government, *n*=10; state government, *n*=2; LGs, *n*=8) mapped the content against 10 predefined categories related to contextual domains of influence on physical activity (Holdsworth et al., 2017) and aspects of physical activity policy planning (Daugbjerg et al., 2009). Sub-categories included social and cultural contextual influences, physical environment, and target groups. Other sub-categories covered

goals/priorities (promoting inclusiveness), and evaluation frameworks (migrant-focused frameworks). Overlaps in workplace environments and integrated initiatives highlighted the need for collaborative partnerships integrating sport into community initiatives and when developing other workplace competencies. There is a promising focus on culturally relevant sports and their role in integration, but more direct initiatives and cross-sector collaborations are needed to explicitly target migrants, especially Indian and other migrant populations in Victoria, where a comprehensive state-level policy is urgently required.

The policy documentary analysis is the first study to reveal critical insights into the prioritisation of migrant inclusionary aspects that inform participation in sport and physical activity in the Australian policy landscape. Migration, and the process associated with resettlement, contribute to global health equity (Hossin, 2020) and should be factored into addressing challenges when promoting equitable physical activity participation across the Australian population. The challenges migrants face can be particularly heightened in the policy context of Australia's rapidly rising migrant population (Australian Bureau of Statistics, 2023), which necessitates their inclusion in sport and physical activity within Australian sporting cultures.

9.2. Significance of findings

The following section first briefly contextualises the issue of low physical activity participation levels among the Indian population, to position implications identified from the key findings across four studies, which are presented below.

Contextualising the issue of low physical activity levels

Indians exhibit low physical activity levels in both their country of origin (Sarkar et al., 2024; Sullivan et al., 2011) and adopted host countries including Australia (Daniel, Wilbur, Marquez, et al., 2013; Hayes et al., 2002; Kolt et al., 2007; Mahajan & Bermingham, 2004; Nisar et al., 2024; Tremblay et al., 2006; Williams et al., 2011) perpetuating their health risk in terms of NCDs, in India and the host country (Ardeshna et al., 2017; Gidwani et al., 2021; Hastings et al., 2015). Globally, their social contexts are reported as a key barrier to physical activity participation (Daniel et al., 2018; Fernandes et al., 2023; Gupta et al., 2017; Horne & Tierney, 2012; Sawrikar & Muir, 2010), yet physical activity research has not fully explored how social and cultural contexts influence physical activity and sedentary practices. Migration and other diverse contextual influences on physical activity and sedentary behaviour among ethnic minority populations living in high-income countries (Holdsworth et al., 2017) is underexplored for Indian migrants.

This study addresses the gap in the understanding of how contextual influences and migration shape physical activity uptake in the Indian population. Within a multistage research framework (Fetters et al., 2013), this study is the first to apply the exploratory sequential design in research on physical activity and sedentary behaviour. Doing so with a cohort of Indian migrants in Australia also addresses other gaps, particularly the lack of culturally specific measures adapted to this migrant population, and introduces context-based tools to identify the key sociocultural factors influencing physical activity participation. The parallel policy study assesses the current policy landscape in regard to Australian sport and physical activity, providing an institutional and policy-informed landscape and context of migrant communities.

The rationale presented in Chapter 1, highlighted the need to explore the contextual factors influencing these changes, to help provide crucial insights when capturing the full scope of their physical activity behaviours and practices. Having explored what physical activity and sedentary behaviour mean to Indian migrants, the work presented in this thesis addressed the change in physical activity and sedentary practices with migration, which are insufficiently addressed in existing physical activity research in Australia. Migrating from low-income countries like India to high-income host countries like Australia could fundamentally changes the sociocultural nature of sports, and the physical activity settings and practices are different from those traditionally available and familiar to these migrants. Although sport and physical activity policy documents reviewed in Study Four, acknowledge the recent and rising Indian migrant populations in Australia, they under-represent a strategic focus that promotes and addresses migrant-specific contexts and challenges in accessing and engaging with physical activity. Tailored strategies are needed to address barriers and promote the physical activity uptake supporting the overall health and well-being of Indian migrants. The implications and recommendations are aimed at informing the promotion of physical activity and facilitating the integration of Indian migrants in Australia.

Implications for physical activity uptake and health promotion among Indian migrants

1. Pre- and post-migration sport and physical activity participation patterns

This theme explores how migration influences the physical activity patterns of Indian migrants and highlights how local government adapt their approach to be socially inclusive and culturally responsive in supporting migrant participation in physical activity.

Shifts in physical activity participation settings

Study Three, presented in Chapter 7, showed that when living in India prior to migration, participants reported engaging in physical activities commonly practised in team-based settings. However, following migration, this shifted to more individual forms of physical activity (χ^2 = 28.43, $p < 0.001$, V = 0.4), with individual participation increasing from 7% to 26.5%, and team participation decreasing from 18% to 8% (Chapter 7). The limited team-based experiences after migration may contribute to the perceived lack of social connection among Indian migrants (Chapter 5), as team-based environments typically foster a sense of community (Eather et al., 2023; Spaaij & Schulenkorf, 2014). This is reflected in the views on physical activity expressed by participants, who stated that *"if you want physical activity, you enjoy it with more people"* [Participant Chapter 4]. Local government documents (Chapter 8) highlighted the role of *"informal team sports"* [LG ID 13, Recreation sector] in bringing diverse nationalities together for migrant integration, supporting the need for team-based participation settings. Settings that encourage group-based physical activity (Horne et al., 2018) can help Indian migrants overcome or mitigate their perceived lack of social connection to engage in physical activity in adopted host countries, including Australia (Sawrikar & Muir, 2010); this may also help alleviate the psychological challenges migrants face during acculturation, such as depression, loneliness, low self-esteem in the US (Bhattacharya, 2011), and threats to ethnic identity previously observed in Indian migrants in Australia (O'Callaghan et al., 2021). In the present study, the positive association between changes in fusion (cultural) identity partially explained the variance in physical activity levels post-migration. Promoting group-based participation could foster cross-cultural connections, support positive psychological outcomes, and encourage physical activity uptake among migrants.

Shifts in the type of physical activity

Study Three (Chapter 7) showed significant shifts in the type of activity (aerobic, muscle strengthening, combination) Indian migrants engaged in ($\chi^2 = 25.69$, $p < 0.001$, V = 0.4). A greater proportion of participants reported engaging in a combination of muscle-strengthening and aerobic activities after migration than when living in India. In India, more participants reported engaging in aerobic forms of physical activity (Chapter 7, section 7.3, Table 12). These results expand on one participant's view related to easier availability of and therefore engagement with in gyms and clubs (Chapter 5): "*Because in every suburb practically you can find a tennis court and a volleyball court and gyms almost in every street"* [P16]. This availability could contribute to the greater proportion of participants' uptake of muscle-strength-based activity, and engagement in both muscle-strengthening and aerobic physical activity in Australia. This

perceived availability of sport and recreational facilities in Australian settings may explain the contrary findings of fewer Indians participating in muscle-strengthening exercises in the US (Jonnalagadda & Diwan, 2005). As walking is a commonly reported practice for Indians living in the US (Daniel, Wilbur, Fogg, et al., 2013; Misra et al., 2005), the UK (Hayes et al., 2002) and Australia (Fernandez, Rolley, et al., 2015; Mahajan & Bermingham, 2004), it might further explain the observed uptake of the combination of aerobic and strength-based activities. Note that the study categorised walking as an aerobic activity (Appendix M).

The reported lack of participation in cultural activities post-migration (Chapter 7) has broader implications, not only for the settings in which physical activity occurs but also for the types (aerobic, muscle strengthening) of physical activity promoted. This reported lack of cultural participation complements the perspectives unravelled during the qualitative phase (Chapter 4) regarding sociocultural nuances, such as class or caste intersections and regional and gender roles, which participants highlighted as important factors influencing physical activity engagement, in particular, when women migrate to high-income host settings. For instance, *"In south India, every family household encourages girls to take part in dance. … that may not be the case in another part of India, … when you come to Australia [dance] may not be applicable here*" [Female participant, Chapter 4]. Such insights point to regional subethnic differences in cultural upbringing that impact the settings and types of physical activity also reported in Chapter 4.

Bridging the gap: Adapting local government approaches for physical activity participation among Indian migrants

Chapter 8 showed that LGs recognising the "*recent influence of the South Asian migration*" [LG ID 17, Sports sector] have adopted a tailored approach to introduce new formats for traditional sports, such as developing "*a social cricket competition in a 50-week format*" to engage the South Asian community. Additionally, this study highlights how facilities should "*respond to the changing and emerging needs of the local community through flexible design where one, two, or three different sports may operate from the same facility*" [LG ID 17, Sport sector]. That report also noted that "*sports including kabaddi and pencak silat are beginning to develop and seek places to play*." Considering the shifts in physical activity types (Chapter 7), where few Indian migrants participated in a combination of different activities with low cultural engagement, questions are raised about the success of flexible designs alone in accommodating multisport engagement. Incorporating traditional activities (dance, kabaddi) into these designs could offer a responsive approach to better engage diverse subethnic Indian migrant populations and the shifting needs and practices of Indian migrants, as well as aligning with policies aimed at fostering greater participation and inclusivity in multisport settings.

2. Targeting newly arrived migrants

In Chapter 7, Study Three provides evidence that the length of stay of Indian migrants surveyed in a new country affects physical activity levels, and policies should take this into account when planning initiatives for migrant groups. Our findings showed a significant difference in physical activity levels for individuals who had resided in the host country for 15+ years (101.82 minutes per week; $p = 0.018$) compared to those who had resided in the country for between one and five years (- 102.18 minutes per week; $p = 0.001$). This has significant policy implications in regard to effectively identifying target populations in planning policies.

Australia's recent policies within the sport and recreation sector (sports plan, sports strategy) tend to broadly categorise target groups as *"migrants"* or *"culturally and linguistically diverse"* populations [National ID 2; National ID 9]. Such broader categorisation may overlook the specific needs of different migrant subgroups (Pham et al., 2021). Offering more granularity in identifying target groups like "new arrivals" [National ID 8, Immigration sector] or "newcomers," and including youth "aged 15 to 25 years" [National ID 7, Immigration sector], had led to more focused initiatives for these groups. As discussed in Chapter 8, countries such as Denmark, Finland, Romania, and England implemented granular targeting based on life stages (working age, children, aging population), ethnic groups, place-based participation sites like sports clubs, sports volunteers, immigrants and ethnic minority populations (Hämäläinen et al., 2015). A focus on these sub-population target groups may offer national-level strategic insight. However, their applicability to Victorian LG areas with Indian migrants must be critically evaluated. Differences in migration patterns, sociocultural factors, and local environments must be considered. Based on the findings presented in the present study, it is recommended that Victorian LG areas and the Victorian State Government should benefit from targeting new migrants (one to five years post-migration), considering this group of Indian migrants showed a notable decline in physical activity levels.

3. Promoting active workplace settings

Study Two adapted a pre-migration/post-migration survey instrument. Administering this adapted survey in Study Three (Chapter 7), the findings showed a significant increase in the proportion of employed Indian migrants compared to students, with the proportion rising from 19.8% to 37% post-migration ($p < 0.001$). The greater proportion of employed Indian migrants in our study may expand on the participants' views, particularly from individuals in the IT sector,

where "*most of the time I'll be sitting in a chair doing my work*" [P16] in desk-based jobs contributed to increased sedentary time in the workplace (Chapter 5).

The policy study demonstrated how, in a workplace setting, using sport as a component of social connection benefited youth migrants. Specifically, how the immigration sector implemented "*more integrated approaches*" using sport in initiatives aimed at developing workplace competencies also helped "*create strong social connections"* [National ID 7] among migrant youth. Integrated approaches could be applied to new arrivals and sedentary workplaces, particularly for students aged 15 to 25 and adults in desk-based roles. Such initiatives may help limit the sedentary behaviour reported among Indian migrants, considering the nature of jobs in host countries like the UK (Sarkar et al., 2017) and Australia (Nisar et al., 2024) with long hours spent sitting. These insights would benefit from future research that measures overall sedentary time and explores the factors associated with workplace sedentary practices among Indian migrants in Australia and other host countries.

4. Adapting physical environments to promote access

Chapter 8 provided evidence of the state government in Victoria focusing on *"Active environments accessible, high-quality places and spaces can increase population-wide physical activity levels*" [State ID 12, Sport and recreation sector]. This document emphasised promoting *"the availability of active places and spaces, along with the development of high-quality sports and active recreation infrastructure,"* [State ID 12, Sport and recreation sector] directing efforts based on several factors, including changing demographics. These policy insights complement the participants' (Chapter 5) recognition of the greater availability of facilities and built environment features available for sport and recreational physical activity when living in Victoria, Australia, compared to India. As one man noted, "*Even on the road they keep space for bicycle riders, respecting the bicycle riders and giving them [the] way. It's a very good experience I have received here"* [P21]. In contrast, insights from Indian women highlighted the need to address accessibility. They pointed out barriers to engagement, such as "*lock-in contracts*," and mentioned that "*indoor activity ... costs money. That is a constraint*" [P15], positioning cost as a barrier to accessing recreational facilities after migration. This study's findings diverge slightly from the broader literature, particularly the report on a study of Indian women in Sydney, who did not perceive cost as a barrier to sports and physical activity (Sawrikar & Muir, 2010). Such findings of the present study remain consistent with the broader literature on cost barriers for sport and physical activity participation among Indian and South Asian migrant women in the US, Canada, and the UK (Babakus & Thompson, 2012), including CALD communities in Australia (Wang et al., 2023).

For the Indian migrant population, the focus likely centres less on the availability of space and more on accessibility barriers, which may also be linked to the broader social and cultural factors discussed throughout this study. This policy study's findings complement this approach. LGs recognising the *"recent influence of South Asian migration"* [LG ID 17, Sports sector] considered no-fee options and developed a *"social cricket competition in a 50-week format"* which resulted in *"more people developing interest and participating"* [LG ID 17, Sports sector]. This demonstrates a responsive approach to meeting the needs of local communities and complements the views of Indian women on the cost barriers above. As recently noted by Wang et al. (2023), CALD communities in Australia face barriers to accessing facilities, primarily due to the lack of adaptation, including financial considerations. Insufficient access to facilities has also been reported for Indians in the US and UK (Daniel et al., 2018; Horne et al., 2013).

The question of how best to promote access to sports and physical activity facilities requires further exploration. Examining the association between key factors related to accessibility within the physical environment, not considered in the present study, could be valuable for future research. It would be useful to examine how these issues of access versus availability differ across diverse migrant populations, considering whether barriers vary by ethnicity or other contextual factors. Exploring whether there are gender differences concerning access to sport and recreational facilities in the physical environment would also help validate the views shared by men and women in our study.

5. Use of sport to facilitate migrant community inclusion and cultural integration

The influence of social and cultural factors on physical activity participation levels among Indian migrants is evident across the qualitative, quantitative and policy studies undertaken in this current research. Quantitative analysis (e.g., B = 25.612, R^2 = 0.126 for social support and B = 10.85, R^2 = 0.116 for social cohesion) provides empirical evidence of the significant relationship between changes in these forms of social capital, particularly at the neighbourhood level, with change in physical activity levels following migration. This confirms the participants' perceived lack of social connections in Australia, particularly within local neighbourhoods and the wider community, reflecting the close-knit nature of communities in India.

Notably, changes in social support were a significant factor influencing physical activity levels from pre- to post-migration (adjusted R^2 = 0.225, 21.56 minutes of physical activity per week; p = 0.007). This suggests that when social support improves, physical activity levels increase by about 21.56 minutes each week. The finding expands on the views captured in Chapter 5, where

a participant stated that *"In India, you have a stronger community. ... Here [Australia] you don't know your neighbours. [In India] your neighbour literally comes past your door and is like, do you want to go for a walk?"* [P11]. Endorsing the idea of the importance of social support at the community level another participant shared, "*I didn't have any friends … my life was sedentary initially … when I met friends who were engaged in dance, and Zumba and swimming…I could relate it to what life I had back at home."* [P9].

These findings have policy implications in relation to fostering social support and social cohesion for Indian migrants in Australian communities. This is particularly important given the shifting Australian demographic, with the increasing number of migrants, particularly from South Asia and India (Chapter 8). By enhancing social support and integrating cultural preferences into sports and physical activities, not only can Indian migrants' participation in physical activity be improved, but broader social integration into Australian society can also be facilitated. This is critical to supporting this participant's view: "*The big game here is footy [Australian Rules Football]. … We'd like to know [about] the sport. … We didn't have access to it before coming here … knowing something like footy would definitely help you integrate"* [P10].

Policy findings from Chapter 8, which reported on the nominal category of social and cultural inclusivity in sport, highlight that "*Sport can bridge the gaps between diverse communities … introducing newcomers to local communities, assisting people in making friends, establishing social networks, gaining a sense of belonging and staying physically active"* [National ID 5, Sports sector]. This diverges from the quote above, raising questions on the implementation of mainstream sport to support the integration of migrants in Australia. As discussed in Chapter 8, monoethnic groups can create divides (Smith et al., 2019) and the suggestion emerging from this research is to organise mixed ethnic groups, where footy is used to bring together Australian and (Indian) migrant populations.

Future research could focus on integration efforts involving mixed ethnic groups using national mainstream sports, for example, footy, to facilitate integration and participation in physical activity. Such insight could inform policy implications supporting claims at the national level that sport can serve as a tool for social inclusion. For this cohort of Indian migrant participants, whose perspectives on and practices of physical activity and sedentary behaviour revolved around the social contexts (Chapter 5), prioritising sport for social integration and uptake of physical activity may well require the LGs to consider their

> *"continual growth and development of [LGs'] diverse community brings new sports and new ways to engage newly arrived communities from south and southeast Asia,*

Africa and the Middle East are seeking different sports and changes to existing formats of participation." [LG 17, Sports sector]

While new strategies are required to accommodate the cultural preferences and practices of Indian migrants, the role of Australian mainstream sports practices could partly facilitate this process. This reflects a responsive approach to facilitating the integration of Indian migrants into and through Australian sporting culture.

Leverage digital platforms to support migrants' social integration and physical activity participation

This study has presented evidence to argue that social resources may be fundamental in facilitating the integration of Indian migrants and promoting their participation in physical activity in Australia. Findings from the qualitative interviews in Chapter 5 and content analysis in Chapter 8 revealed complementary aspects of how participants' need for social and material resources can facilitate the integration and the uptake of physical activity. For instance, the content analysis highlighted the Australian Government's initiative to launch *"an online interface in October 2019"* aimed at migrant and humanitarian entrants *"to facilitate bringing the community together"* [National ID 8]. This is a proactive response to the immigration sector's appeal for "*a digital platform aimed at facilitating integration directly with volunteers who are offering assistance and practical support*" [National ID 7]. This initiative mirrors the qualitative insights of participants who mentioned a preference for using online social platforms like *"Meetups"* [P3] to engage in physical activity and connect with wider community members acknowledging that *"These kinds of apps really help"* [P3].

These findings have implications for policymakers and community organisations in Australia in relation to providing access to sport and physical activity, both offline and/or supported with digital platforms, to foster migrant social inclusion and encourage participation in physical activity. The findings suggest integrating both social and material resources into migration policies and public health initiatives to help 'bridge gaps' in social integration and encourage a more active, healthy Indian migrant population in Australia. Future research could examine the role of digital apps in promoting physical activity among Indian migrants in Australia.

6. Tailor holistic health messaging using cultural and cross-sectoral co-design between exercise and health sectors

The quantitative dataset (Chapter 7) showed significant associations in receiving health advice related to physical activity from general practitioners and allied health professionals in Australia compared to India ($\chi^2 = 6.7$, $p = 0.001$). These quantitative findings build on the qualitative data

set supporting the participant views that revealed the differences in the access, opportunity and health messaging experiences received more in Australia than in India. As a participant stated, *"You have more opportunities [with allied health care] from state-wide or [a] national initiative which I can't even imagine in India. … And the value and importance* of *physical activity is stressed, it's spoken about"* [P14]. Such findings confirm that primary healthcare providers delivering migrant-friendly health messaging could facilitate physical activity uptake and improve health outcomes for Indian migrants in Australia. However, as discussed in Chapter 5, there are challenges when only a limited proportion of allied health professionals are aware of the physical activity components – type, intensity, and duration – in Australia (Freene et al., 2019). The holistic health perspectives of the participants were reflected in Chapter 4 where it was noted that "*Physical activity means the overall development of a person … mentally as well as physically"* as well as that "*physical activity is also being outdoors and walking with friends."* These perspectives are similar to those reported among Indian migrants living in the US and Canada, who related physical activity with spirituality (Hinduism) and cultural experiences like yoga, and pranayama-breathing (Galdas et al., 2012; Kalavar et al., 2005). Such holistic perspectives have implications for tailoring health promotion messaging that goes beyond physical benefits to include the broader social, mental, and spiritual well-being. The consideration of broader religious and cultural perspectives has previously been emphasised in the healthcare management of Indian migrants in Australia (Ahmad et al., 2022).

Interventions that are culturally tailored and incorporate holistic approaches resulted in better health outcomes, including enhanced physical activity, for ethnic minority populations in Canada (Murdoch-Flowers et al., 2019). Co-designing initiatives between general practitioners and exercise professionals from Indian backgrounds could better address the sociocultural and migration-related needs of this population. Collaboration between the health and sports sectors, which may currently be limited (Chapter 8), is encouraged, to align with the proposed 2030 goals of the health sector: *"Healthcare professionals are trained and supported to provide advice and support to patients to promote physical activity and engage in social prescribing (connecting patients with community services to improve health and well-being)"* [National ID 3].

9.3. Strengths and limitations

This study enables cross-country comparisons of diverse contextual influences on physical activity and sedentary behaviour before and after migration. For the Indian migrant population, this is complemented by adapting and pretesting a culturally appropriate survey to measure change in physical activity levels (including sports participation) and lesser-known factors such as primary healthcare experiences, workplace environments, and social influences. Validating

this survey through the co-design process with Indian migrant community representatives and research experts strengthens its relevance and adaptability to the contexts and practices of Indians in their country of origin and their host country, Australia. The tool can be adapted to contextual settings in host countries besides Australia to support measuring the change in sociocultural contextual influences and overall physical activity levels of Indian migrants.

A key strength is adopting diverse contextual domains, particularly those suited for ethnic minority populations (Holdsworth et al., 2017), as a framework to guide this thesis highlights how migration impacts physical activity and sedentary behaviour, strengthening the understanding of intersections between different contexts. Commonly adopted frameworks within physical activity research, such as the socio-ecological model (Sallis et al., 2006) overlook migration-related domains of influence when exploring the social determinants of health. By addressing a range of contextual influences, for instance, sociocultural factors, and physical and workplace environment, and including government policy analysis, this thesis provides a more migration-inclusive and contextually comprehensive perspective to the research.

The study's recommendations are drawn from primary data collection sources, with triangulated findings from interviews, surveys, and documentary content analysis. The corroborated results across these diverse data sources strengthen the validity and reliability of the conclusions and recommendations. Further, engaging an interdisciplinary team of experts from fields such as sport, exercise, physical activity, cultural studies, public health, medical anthropology, and applied statistics brought a diverse skill set to overseeing the conduct and analysis of this mixed-methods research, adding rigour to the interpretation of findings. Overall, this approach fills a significant gap in existing physical activity research on the Indian migrant population in Australia, providing unique, comprehensive insights into their sport participation and practices of physical activity and sedentary behaviour.

Limitations

"Research is a process, not just a product" (England, 1994, p. 244).

In addition to the limitations articulated for each study, the following limitations should be considered when interpreting the overall results. A pertinent question is whether 'forefronting' the policy study could lead to different conclusions or findings. The typical application of the advanced mixed-methods framework employed in this research is to evaluate and/or develop policies, programs, or interventions (Fetters et al., 2013; Fontana et al., 2024). Approaching the policy at the end may have allowed for a more unbiased approach in providing empirically rich

policy insights in formative research prioritising the needs of Indian migrants. Future research could frontload a policy (or program) component, engaging policymakers and key stakeholders and practitioners in and across different stages of research aimed to develop or evaluate a policy and/or program suited to the needs and practices of Indian migrants in Australia.

The mixed methods design also introduced several inherent biases. For example, social desirability bias may have influenced participants' responses in Studies One and Three. Insider bias may also have impacted the planning, such as including the Indian philosophical lens when reporting the findings, although the inclusion of non-Indian team members from New Zealand and Australia may have mitigated this (Dever et al., 2021).

Although the sample in the second quantitative phase was larger than and distinct from the sample engaged in the qualitative phase, the smaller-than-expected analysis of 81 participants compared to the originally estimated 364 warrants caution regarding the generalisability, particularly of the quantitative findings. Cross-sectional studies on physical activity among Indian participants have varied in sample size, ranging from as few as 56 reported previously to 93 reported recently in Australia (Misra et al., 2005; Nisar et al., 2024). The current sample was limited to individuals with tertiary education. Future research could expand the sample by including individuals from diverse educational, religious and non-English-speaking backgrounds not included in the present study. Individuals from these backgrounds might experience different contextual influences that are further influenced by migration-related changes. A shorter version of the overall instrument could help address any issues arising from the time needed to complete, which may also have further impacted the sample size. While this research sought to include second-generation Indians, their representation was insufficient to be able to draw any conclusions on generational differences. Therefore, the findings and corresponding recommendations, including policy implications, are more relevant to first-generation Indian migrants.

The limited search and validation measures of this research should also be acknowledged. For the sequential component, the literature search strategy could have adopted additional member checking to enhance the rigour and use of the checklist in the critical appraisal during the search process for the integrative review (Dhollande et al., 2021). The search was limited to peer-reviewed academic journal publications, excluding other scholarly sources such as books, chapters, and relevant dissertations. As a result, the study did not cover the full range of research studies undertaken. The search was limited to including empirical literature that informed Studies One to Three of the sequential components. An updated summary of findings and

empirical qualitative and quantitative studies is provided as Appendix S. The survey instrument could have benefitted from a test-retest reliability process to strengthen its validation measure. For the policy study, involving past or current policymakers in the review of final documents could have confirmed the inclusion of the most appropriate documents for analysis or could have provided help in identifying any missing ones.

This research study design demanded significant time, careful planning and coordination and specialised expertise in analysing diverse data sources (Almeida, 2018; Creswell & Clark, 2017). Such challenges were exacerbated during the COVID-19 pandemic in Melbourne, which was the most locked-down city in the world (Tuffield, 2021) constraining residents within the state of Victoria who faced social costs (financial loss, stay-at-home orders, observed curfew of 5km radius) (Kampmark & Christie, 2021). These may likely have contributed to some of the aforementioned limitations as concerns about online scams were frequently raised by respondents during recruitment and may have contributed to scepticism about completing the survey online in the post-COVID-19 period.

Time and budget constraints on the overall PhD project timeframe resulted in the data from the Social Network Analysis (SNA) tool not being presented in this thesis. The tool was developed for Indian migrants as part of the instrument design stage (Chapter 6). Future research could independently administer the SNA instrument to corroborate findings with other Indian migrants globally. By gathering data from a larger sample and incorporating the SNA tool, future research could expand on or complement findings on social influences, particularly the role of social networks in sport and physical activity among Indian migrants.

9.4. Recommendations for future research and policy

Key recommendations for researchers in sport and physical activity working with migrant Indian populations and policymakers involved in the sport and recreation sector are presented below.

For research practice

1. Consider a contextual approach: Research should be framed within Indian cultural and philosophical contexts. This includes aims that focus on how cultural nuances and perspectives may influence the planning and execution of the research, and the reporting of findings.

For policy

2. Target new arrivals: The national sports sector should explicitly reach out to, involve, and support participation of newly arrived migrants, adopting a whole-of-population approach that fosters an inclusive environment, integrating migrants into mainstream community sporting activities.

3. Promote active workplace policies: Workplace policies should encourage physical activity, such as 'active' walking meetings, lunchtime yoga, or walking groups. Additionally, offering incentives for Indian workers who accumulate the highest step counts, or providing newcomer incentives, can help support the integration of new Indian migrant workers and students.

4. Actively involve migrant champions with sporting backgrounds: Engage Indian migrants with demonstrated and reputed sporting backgrounds, both from India and from Australia and/or other high-income host countries, in co-design efforts to adapt current and future policies. Position these individuals as key ambassadors to promote sport and physical activity within migrant communities. This approach should focus on areas with high migrant-populated surburbs in the state of Victoria and key LG areas.

In fostering collaborations between sport (and exercise) and the health industry

5. Collaborate with Indian migrant exercise professionals: Collaborate with Indian migrant exercise professionals who understand the cultural nuances of the community to promote physical activity. These collaborations should also involve general practitioners and allied health professionals to ensure holistic support.

6. Implement pay-as-you-go or come-and-try schemes: Introduce a pay-as-you-go scheme or come-and-try days for recently arrived Indian migrants with less than five years of residence. This could be offered through general practitioner or allied health screening consultations as a referral option to engage Indian migrants in community physical activity and sporting cultures.

9.5. Future dissemination

Disseminating the research findings is a key aspect of this study's impact, ensuring knowledge translation to both academic and community stakeholders. Key strategies, listed below, can help effectively communicate the findings and engage diverse audiences.

1. *Journal submission*

The content from Chapters 6 to 8 will be restructured to align with the requirements of relevant academic journals. This will include the dissemination of data and findings from the work carried out with the Social Network Instrument.

2. *Conference presentations*

Plans are underway to present at academic and professional conferences to engage with peers and policymakers for a critical exchange on the subject and to implement the translation of findings.

3. *Community distribution and engagement*

The research findings will be shared with the community through widely accessible methods, such as key organisational community meetings, newsletters, and social media platforms. Workshops will be conducted to feed the findings back to the community.

4. *Collaborations and networking*

Connections will be made with key stakeholders in relevant sports and health sectors. Supervisors' networks will help facilitate these connections, leading to collaborations, funding, and research opportunities in the public health field, intersecting with areas of sport, exercise, and recreation.

9.6. Conclusion

Conclusively, this thesis has described how the key contextual factors influence the participation in physical activity and sedentary behaviour of Indian migrants in Australia. Key findings revealed that Indian migrants held holistic health perspectives on physical activity and sedentary behaviour, with diverse contextual domains of influence impacting their physical activity behaviours as migrants in Australia. The qualitative phase offered a nuanced understanding of how Indian migrants define and perceive physical activity and sedentary behaviour. Participants' comparisons between their native experiences in India and their new context in Australia provided deep insights into how migration influences behaviour, particularly through the intersection of sociocultural factors with the physical environment, health communication, and activities of daily living. These insights diverge from the 'one-size-fits-all' approach of existing physical activity measurement instruments and have informed the adaptation of a culturally tailored instrument for measuring key sociocultural contexts examined

during the quantitative phase of the research. The findings are reflected in a broader contextual perspective related to physical activity participation by highlighting how policy and research-related practices could account for migration influences from India and Australia.

Within the multistage research framework describing perspectives on physical activity and sedentary behaviour, and measuring these behaviours, the exploratory sequential design fulfilled its aim to critically explore and measure key contextual factors (e.g., sociocultural factors) associated with the patterns of engagement in sport and physical activity among Indian migrants living in Australia. This was complemented by parallel policy insights, using evidence-based findings to guide and customise policy recommendations that ensure equitable access and opportunities for migrant participation in sport and physical activity in Australia. As a result, this thesis offers a significant and unique contribution to the fields of sport and recreation within the disciplines of public health, human society, and cultural studies.

The Indian migrant population has seldom been examined in this context in the literature, providing valuable insights into their perceived and actual physical activity and sedentary behaviour practices, including sport participation. The findings and recommendations presented in this thesis are intended to enrich the discipline of public health policy. Furthermore, this research has provided novel empirical knowledge to researchers and policymakers, enabling them to increase physical activity participation and enhance health promotion practices for Indian populations. Since the survey can be adapted to various migrant groups, and the policy implications can influence other states and LGs in Australia, these recommendations are likely to support policy and research efforts beyond the Victorian state and local contexts, and are transferable to other ethnic migrant communities.

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APPENDICES

Appendix A. Co-authorship protocol

Co-authorship contributions within this thesis

Student and supervisor approvals

By signing you are confirming that the co-author contributions stated in the table(s) below are accurate.

Student Name	Siona Fernandes	**Signature**	S.F	**Date**	28.4.25
Supervisor Name	Tom Stewart	**Signature**		**Date**	29.4.25

Chapter Number:	4
Manuscript Title:	A qualitative exploration of perspectives of physical activity and sedentary behaviour among Asian Indian migrants in Melbourne, Australia: how are they defined and what can we learn?
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Reference if published:	Fernandes, S., Caperchione, C. M., Thornton, L. E., & Timperio, A. (2021). A qualitative exploration of perspectives of physical activity and sedentary behaviour among Indian migrants in Melbourne, Australia: how are they defined and what can we learn? *BMC Public Health*, *21*(1), 2085. https://doi.org/10.1186/s12889-021-12099-4
AUTHOR SURNAME:	CONTRIBUTION
Fernandes	Conceptualisation, study design, data collection, Data coding and analysis, writing of original and revised drafts for intellectual content
Caperchione	Validation, methodology, supported review and feedback manuscript, critiquing interpretation and reporting
Thornton	Supporting aims, study design, supported review and feedback manuscript, critiquing interpretation and reporting
Timperio	Supporting aims, study design, supported review and feedback manuscript, critiquing interpretation and reporting

Chapter Number:	5
Manuscript Title:	Qualitative insights on the importance of sociocultural contexts on Asian Indian migrant participation in physical activity and sedentary behaviour.
Publication Status:	Published
Reference if published:	Fernandes, S., Hinckson, E., & Richards, J. (2023). Qualitative Insights on the Importance of Sociocultural Contexts on Asian Indian Migrant Participation in Physical Activity and Sedentary Behavior. *Journal of Physical Activity & Health*, *20*(11), 1051–1057. https://doi.org/10.1123/jpah.2022-0656
AUTHOR SURNAME:	CONTRIBUTION
Fernandes	Conceptualisation, study design, data collection, data coding and analysis, writing of original and revised drafts for intellectual content

Hinckson	Supported manuscript review and feedback.
Richards	Supported manuscript review and feedback.

Chapter Number:	6
Manuscript Title:	Adapting surveys for Asian Indian migrants: Exploring experiences of physical activity and sport in the pre- to post-migration context
Publication Status:	Unpublished/Ready for submission for Publication
AUTHOR SURNAME:	CONTRIBUTION
Fernandes	Conceptualisation – Ideas; formulation of aims, investigation - specifically conducting research and formal analysis, development, and design of methodology, writing the original manuscript, revisions to published work.
Hinckson	Supported the development of methodology, feedback and review of pre-publication draft revisions.

Chapter Number:	**7**
Manuscript Title:	Sociocultural correlates of physical activity and sport among Asian Indians in Australia: A pre-to-post migration observational study.
Publication Status:	Submitted for Publication
AUTHOR SURNAME:	CONTRIBUTION
Fernandes	Conception, survey design, data acquisition, data analysis, interpretation, and critical writing of original and revised drafts for intellectual content.
Stewart	Supporting data analysis and interpretation, revisions to pre-publication drafts

Chapter Number:	**8**
Manuscript Title:	Fernandes, S, Holroyd, E. (2025). Fostering equity in and through sport: a content analysis of physical activity and sport policies for migrants in Australia.
Publication Status:	Unpublished/Ready for submission for Publication
AUTHOR SURNAME:	CONTRIBUTION
Fernandes	Conception, design, aims, data acquisition, data analysis, interpretation, critical writing of original and revised drafts for intellectual content
Holroyd	Validation, support finalising results, interpretation, critical review and feedback of original and revised drafts

Appendix B. Ethics approval documents – Qualitative phase I

Ethics approval letter



Memo

To:	Professor Anna Timperio School of Exercise and Nutrition Sciences
From:	Secretary – HEAG-H Faculty of Health
CC:	Dr Lukar Thornton, Associate Professor Cristina Caperchione, and Siona Fernandes
Date:	1 August 2019
Re:	**HEAG-H 93_2019:** ***Exploring Indian migrants' physical activity and sedentary behaviour***

Approval has been given for Professor Anna Timperio, of the School of Exercise and Nutrition Sciences, to undertake this project with the modifications that were requested on the **29 July, 2019**. The project has been given approval as it meets the requirements of the National Statement on Ethical Conduct in Human Research 2007 (Updated 2018).

Please note that the current end date for this project is **04 July, 2020.**

Barbara M Lavelle
Dr Barb Lavelle

Executive Officer
HEAG-H

CRICOS Provider Code: 00113B

2. Participant Information Sheet

Plain Language Statement

Exploring Indian migrant physical activity & sedentary behaviour

Principal Researcher: Professor Anna Timperio
Student Researcher: Siona Fernandes (PhD student)
Associate Researcher(s): Dr Lukar Thornton, Associate Prof. Cristina Caperchione

Research Purpose

Being active and being sedentary (sitting time) can impact one's health. Migration to new countries poses many new experiences and challenges. We are interested in understanding the types of physical activity and sedentary behaviour Indian migrants and people of Indian origin to participate in and what influences these behaviours in Australia. Understanding the experiences of Indian migrants can better inform programs and services that meet everyone's needs. You are invited to participate in a study conducted by researchers at Deakin University.

What does the study involve?

Our student researcher (Siona) will conduct interviews in person or over the telephone/skype with Indian migrants living in Melbourne. The interviews will be audio-recorded and will take around 40 to 45 minutes. In-person interviews will be held at a public location selected by the participant. A second person may be present. We also ask participants to complete a short one-page survey with some background information about themselves. After the interview, participants will receive a $20 retail voucher in appreciation for their time.

How was I chosen to participate?

You expressed an interest to participate in this study either by phone or via an online webpage. Participants must be fluent in English language for purpose of the interview, aged between 18-64 years and live in Greater Melbourne. Participants must also either be: 1) born in India AND migrated to Australia more than one year ago **OR** 2) born in Australia AND have at least one parent who was born in India. All participants must intend to remain in Australia for more than two years.

How do I choose to participate?

Siona will call you after a week to check if you have any queries and confirm if you would like to participate. If you would like to participate, you can choose to bring the signed consent form (attached) and background survey (attached) with you to the interview **or** return it via post in the reply-paid envelope **or** return a scanned copy via email. Thereafter, Siona will either email or call you to arrange a time and location for your interview.

Voluntary participation

We would like to remind you that your participation is voluntary. You can withdraw from the study at any time. Choosing to participate or not will neither advantage nor disadvantage you. Should you no longer wish for your interview to be used in the study, you must let us know within one month of your interview so that we can remove your interview from analyses.

How will my privacy be protected?

All interviews are confidential. Names are removed during analyses. Any identifying information is kept separately from the interview material with access to only the research team. No other person can identify to whom the interview belongs to.

All electronic information is stored on a secure server and hard copies are stored in a secured cabinet within Deakin University. All collected information is securely stored for at least 5 years on completion of the study. Only the research staff linked with the project will have access to the information.

Are there any risks involved?

There are no foreseeable risks with your participation in this study. There are no right, or wrong answers and participants don't have to answer any question they don't want to. Participants can raise any concerns with the interviewer and can stop the interview any time.

Research results

The findings from this study will be published in scientific journals and presented at conferences and to health agencies and community groups. They will also form part of the student's PhD thesis. No information will be presented about individuals. While we may use quotes from interviews, no one will be identifiable.

If you would like to receive a summary of the findings, please tick this box on the consent form.

Further information

For further information or any questions, please contact Siona Fernandes on Ph: X X X or email fernandess@deakin.edu.au

Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a participant, please contact:

The Human Research Ethics Office, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, research-ethics@deakin.edu.au. Quote Project number [201X-***xxxJ.***

Please keep this plain language statement and a copy of the consent form for future reference

"This study has received Deakin University ethics approval (reference number: Insert here)."

3. Consent Form

CONSENT FORM

Date:

Reference Number:

- I have read and I understand the Plain Language Statement (study information).
- I freely agree to participate in this project according to the conditions in the Plain Language Statement.
- I was given a copy of the Plain Language Statement and Consent Form to keep (email/post).
- I understand that the researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.
- I understand that the interview will be conducted in English and will be audio-recorded.
- I understand that all results will be summarized and used for research purposes and may be reported in scientific and academic journals and conference meetings. Quotes may be reproduced, but I will not be identified.
- I understand that I am free to withdraw from this study at any time. After my interview I have one month to inform the researcher of my withdrawal.

☐ Please tick the box if you wish to receive an overall summary of the research findings

Participant's full name (printed) ……

Telephone number: Email address:

Signed: …… Date: …….

Appendix C. Ethics approval documents – Quantitative phase II

1. Ethics approval letters



Auckland University of Technology Ethics Committee (AUTEC)

Auckland University of Technology
D-88, Private Bag 92006, Auckland 1142, NZ
T: +64 9 921 9999 ext. 8316
E: ethics@aut.ac.nz
www.aut.ac.nz/researchethics

9 December 2022

Erica Hinckson
Faculty of Health and Environmental Sciences

Dear Erica

Re Ethics Application: **22/223 Exploring Contexts and Experiences of Sport and Physical Activity (PA) before and after migration among Indian Migrants in Melbourne, Australia.**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC).

Your ethics application has been approved for three years until 9 December 2025.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the Auckland University of Technology Code of Conduct for Research and as approved by AUTEC in this application.
2. A progress report is due annually on the anniversary of the approval date, using the EA2 form.
3. A final report is due at the expiration of the approval period, or, upon completion of project, using the EA3 form.
4. Any amendments to the project must be approved by AUTEC prior to being implemented. Amendments can be requested using the EA2 form.
5. Any serious or unexpected adverse events must be reported to AUTEC Secretariat as a matter of priority.
6. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEC Secretariat as a matter of priority.
7. It is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard and that all the dates on the documents are updated.
8. AUTEC grants ethical approval only. You are responsible for obtaining management approval for access for your research from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

Please quote the application number and title on all future correspondence related to this project.

For any enquiries please contact ethics@aut.ac.nz. The forms mentioned above are available online through http://www.aut.ac.nz/research/researchethics

(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat
Auckland University of Technology Ethics Committee

Cc: beingsiona@outlook.com

This is the final amendment approval letter to proceed with Pilot phase.

AUT
TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

Auckland University of Technology Ethics Committee (AUTEC)

28 March 2023

Erica Hinckson
Faculty of Health and Environmental Sciences

Dear Erica

Re: Ethics Application: **22/223 Exploring Contexts and Experiences of Sport and Physical Activity (PA) before and after migration among Indian Migrants in Melbourne, Australia.**

Thank you for your responses to the conditions for amendments to your ethics application.

The amendment to the data collection protocol has been approved.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the Auckland University of Technology Code of Conduct for Research and as approved by AUTEC.
2. All public facing documents must have the AUTEC approval number and be of a high standard of spelling and grammar. Dates on the Information Sheet(s) and Consent Form(s) must be consistent.
3. Any amendments to the project must be approved by AUTEC prior to being implemented.
4. A progress report is due annually on the anniversary of the approval date.
5. A final report is due at the expiration of the approval period, or, upon completion of project.
6. Any serious or adverse events must be reported to AUTEC, this includes unforeseen issues that might affect continued ethical acceptability of the project.
7. AUTEC grants ethical approval only. You are responsible for obtaining management permission for access from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

The application number and title need to be referenced on all correspondence related to this project.

All forms are available online http://www.aut.ac.nz/research/researchethics

For any enquiries, please contact ethics@aut.ac.nz

(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat
Auckland University of Technology Ethics Committee

Cc: beingsiona@outlook.com

2. Participant information sheet – Pretesting

Exploring the contexts and experiences of Sport and Physical Activity before and after migration among Indian Migrants in Australia

My name is Siona Fernandes, an Indian-born migrant pursuing my PhD degree. This degree creates an opportunity to improve the experiences of sport and physical activity for Indian migrants living in Melbourne, Australia. As a fellow Indian, I invite you to participate in this research study titled 'Exploring contexts and experiences of sport and physical activity before and after migration among Indian migrants in Melbourne, Australia'. Participation is voluntary and you may withdraw at any time.

Purpose of this research

In Australia, there is a growing Indian migrant community and there are few studies on their participation in sports and physical activity. For this purpose, we put together a 20-to-30-minute online survey to better understand how different contexts (e.g., social, cultural, neighbourhood contexts) could matter to them taking part in sports and recreation in Australia, making comparisons with India. This is important to modify programs and inform policy to help with the integration and participation of Indians in sports and physical activity, improving their quality of life after migration to Australia. The information we gather from this study will also be published and presented in both academic and public domains.

You are 'pre-testing' (reviewing) the survey that will later be given to the members of the local Indian population living in Melbourne. The reviewing process helps to ensure the survey questions convey the right meaning with the appropriate use of words that are clearly understood by people from the Indian community and that the questions and the response options are reflective of the experiences, language, and culture.

How was I identified and why am I being invited to participate in this research?

You were either known to the research team with your contact details previously known to the team members or publicly available and are receiving this information sheet because you were identified as:

- A fellow research expert, preferably in survey design, but not limited to, being of Indian heritage with lived experiences in India, or
- An industry professional, or holding relevant social positions like council officer, policymaker, and allied medical/health professional, either of, but not limited to, being of Indian heritage with lived experiences in India who may have actively demonstrated involvement/interest in settings that relate to Indian migrant sport and physical activity, or
- A local Indian community leader who has produced community-led initiatives to promote sport and physical activity for Indian migrants, and/or
- An active member of the local Indian migrant community, aged between 18-70 years, fluent in English, with no disability that limits your participation in sport and/or physical activity.

What will happen in this research?

Initial considerations to participate:

1. Before you take and review the survey you are expected to allocate approx. 15 minutes to read the information screen, checklist and consent screen emailed to you by the primary researcher.
2. You are given two weeks to confirm your participation. During this time you can either contact the primary researcher or our primary researcher will contact you to confirm your participation and have any queries answered.
3. If you choose to participate just sign or write your name in the space provided in the online consent

form.

Once you agree to participate:
1. You require approx. 30 minutes to take/review the survey questions using the criteria in the checklist provided.

2. Once you have completed the survey, the primary researcher will be notified and will contact you via phone call/text/email) to organise a time at your convenience for a 30 minute informal discussion via Zoom/Skype/phone. An appointment link will be sent to you via email.

This discussion is to gather if any, specific feedback or suggestions you may have on the survey which the primary researcher will make a note of. The checklist contains prompts to guide your review with space to note down any comments for discussion.

What are the benefits?
Reviewing the survey questions and providing feedback helps ensure the comprehensibility and appropriateness of a survey instrument tailored for a wider Indian migrant community. Currently, such a tailored instrument for this population is limited. So, your input is valuable on a local and global scale. Globally, contributing a survey instrument to the research community and relevant public health practitioners/policymakers working with or interested in sports and physical activity tailored to Indians.

Once this survey is given to local Indian migrants in Australia it can offer insights to better serve the participation, interests, and integration of Indian migrants via recreational sport and physical activity programs/policies planned in Australia. Thus, locally, your input will serve an under-researched and visibly growing migrant community in Australia. Completing the survey can offer you an opportunity to reflect on your physical activity and sporting patterns and consider the role of migration on the participation in sports and physical activity habits of Indians. As a gesture in return for your contribution, you can opt to receive an oral presentation and/or short report of relevant research insights from our primary researcher.

Who will have access to the data?
Your details will be maintained in a password-protected private database, accessible only to the primary researcher. There will be a numeric code (e.g., 001) given for any data reported to keep your identity confidential. Supervisory team members will have access to a de-identified version (numeric codes) of this database. Data will be reported as a whole, so no individual is identified. All data is stored on an offshore secure server for analysis. The results of this work may be presented at scientific or professional meetings or published in scientific journals, but your identity will not be shared. The data will not be shared with any third party. After the study has been completed all electronic data (including consent forms) will be permanently deleted after 6 years.

How will my privacy be protected?
Your name and relevant contact details will be known to the primary researcher. However, all feedback is reported as a whole, so no individual is identified. When discussing feedback, numeric codes will be used so that your name will not be identified during any discussion related to the reviewing of the survey. We will ensure that your identity is confidential and secure from interception or appropriation by unauthorised persons, or for purposes other than the approved research. We also ensure that all information will be used only to support this research study. As a participant, you have a right to access all personal information held by the researchers at any time (Privacy Act 2020).

What are the costs of participating in this research?
There is NO monetary cost. It is your time that lends a valued contribution to this process.

What opportunity do I have to consider this invitation?
A time frame of two weeks is given for you to consider your response to participate in this study. To extend this time frame, please contact the primary researcher.

Will I receive feedback on the results of this research?
YES. You can opt-in by ticking the "Yes" box option at the end of your survey. You will be emailed a one-page summary of the results.

What are the discomforts and risks?
Although consensus around decision-making is ideal, as a participant in the pre-testing phase, the primary researcher will welcome constructive differences of perspectives ensuring these serve the overall outcome of the study. So, you have an equal opportunity to freely express your opinions. Our primary researcher will encourage you to freely express any queries or discomfort, and remind you of the right to withdraw anytime, unquestioned. Additionally, beyond blue's, Free 24/7 counselling service, can provide you with information and counselling support to help everyone in Australia achieve their best possible mental health, whatever your age and location. If you wish to use the service, please dial their free phone: 1300 22 4636. For more information visit https://www.beyondblue.org.au

How do I agree to participate in this research?
In the consent screen, selecting the option "Yes - I agree to participate in the study" and providing your online signature or name indicates that you agree to participate in the study. Participation is voluntary and you may withdraw at any time. If you choose to withdraw from the study, then you will be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

Future use of my data
Research data are a valuable resource, usually requiring much time and money to be produced. Your de-identified data on the university's secure server will be stored for 6 years. In such time any relevant future analysis of the data provides additional research insights to serve various industries and occupations to better support sport and physical activity among Indian migrants. Information obtained in this study will be used only for research purposes and in ways that will not reveal who you are.

Please contact our primary researcher in Melbourne, Australia, for any support or further information via email or text/call. Any concerns regarding the nature of this project please contact in the first instance: Project Supervisor: Professor Dr Erica Hinckson, New Zealand, mobile, email. Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, New Zealand, ethics@aut.ac.nz, + 64 9 921 9999 ext. 6038. At the end, please retain the downloadable copy of the survey for your reference.

3. Consent form - Pretesting

Please read the statements to consent and take part in this research study

- I have read and understood the information provided about this research project in the Information Sheet dated 28/04/23.
- I have had an opportunity to ask questions and to have them answered.

- I understand that notes taken during the interviews will only be used for purpose of refining the survey as needed.
- I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, the removal of my data may not be possible.
- I agree to take part in the pre-testing (review) of this survey.

[✓] Choose the appropriate option

○ **Yes** - I agree to take part in this research

○ **No** - I don't agree to take part in this research

Sign or write your name below.

Please enter your details. Your details are kept private and confidential.

○ Full Name _____

○ Email _____

○ Phone _____

○ Postcode _____

4. *Participant information sheet – Main study*

Exploring the contexts and experiences of Sport and Physical Activity before and after migration among Indian Migrants in Australia

Namaste,
I am Siona Fernandes, an Indian-born migrant. As a fellow Indian, I invite you to take part in completing an anonymous survey for the research study titled 'Exploring contexts and experiences of sport and physical activity before and after migration among Indian migrants in Melbourne, Australia. As part of pursuing a PhD research degree from AUT University, New Zealand, I would like my research to develop opportunities that improve the experiences of sport and physical activity for Indians living in Australia.

Participation is voluntary. However, if you begin the survey and then decide to withdraw from the study simply close the browser. Details of this study are below.

Purpose of this research
In Australia, there is a growing Indian migrant community and there are few studies on their participation in sports and physical activity. For this purpose, we put together a 20-to-30-minute online survey to better understand how different contexts (e.g., social, cultural, mental-physical health, neighbourhood) could matter to them taking part in sports and recreation in Australia, making comparisons with India. By completing this survey, your responses can help us understand how certain contextual aspects link to the physical activity and sports participation behaviours of Indian migrants.

How was I identified and why am I being invited to participate in this research?
You responded to an advertisement with the survey link, completed some screening questions, and met the eligibility criteria below,

OR

Having heard/read of this study you directly contacted the primary researcher who provided you with the survey link and you successfully met the eligibility criteria:

1. Identified yourself as of Indian heritage:
 - either born in India *or,*
 - born in Australia or another country with at least one Indian-born parent, *and*
2. You have lived/stayed in India for at least one year, *and*
3. You have lived in Australia for at least one year, with an intent to live in Australia over the next two years, *and*
4. You are between 18 to 70 years of age, fluent in English, and with no reported illness or disability that would limit participation in sport and/or physical activity.

This criterion enables individuals of Indian heritage who bring lived experiences mainly of the social, cultural, and physical contexts before and after migration to Australia which better informs the aim of this study. The chosen age group aligns with the current physical activity guidelines for healthy individuals in Australia.

What will happen in this research?
Agreeing to take part in this study requires:

a) Approx. 15 minutes to read this information screen
b) Completion of the online survey also indicates your voluntary consent to participate in the study.
c) Approx. 20-30 minutes to complete the full survey.

What are the benefits?
This information can offer insights that better serve the interests and the integration of Indian migrants via planned recreational sports and physical activity programs/policies in Australia. The survey also benefits the research community globally and other health practitioners/policymakers working with or interested in understanding the sport and physical activity practices of Indians.

Completed surveys enter in a 'draw', where you have an equal chance to win one of thirty-five gift vouchers each valued at 20 AUD. At the end of the survey, you are directed to a separate online screen where you have the option to enter a valid email address only if you choose to enter a prize draw. Winners are notified via the email address provided.

Who will have access to the data?
Data are reported as a whole, to maintain anonymity. Data are NOT shared with any third party. All data are

deleted permanently after 6 years. The results of this work will be presented at scientific or professional meetings or published in scientific journals.

How will my privacy be protected?
This survey is anonymous. No contact details are needed. To ensure best practices to protect and maintain anonymity the following steps are in place:

- We ensure that your information is secure from interception or appropriation by unauthorized persons, or for purposes other than the approved research. This involves the coding of data and data reported as a whole to maintain anonymity.
- Electronic data is stored in AUT's network drives and will be permanently deleted after 6 years.
- We ensure that all information will be used only to support this research study.

What are the costs of participating in this research?
There is NO monetary cost. Your time is a valued contribution.

What opportunity do I have to consider this invitation?
You have two weeks to consider your response to participate in this study. You may contact the primary researcher to extend this time frame.

Will I receive feedback on the results of this research?
YES. At the end of your survey, there is a link to a separate screen where you have the option to enter your email address only if you wish to receive a summary of the research findings.

What are the discomforts and risks?
The likelihood any participant will experience risk is very low. Nonetheless, please note that beyond blue's, Free 24/7 counselling service, can provide you with information and counselling support to help everyone in Australia achieve their best possible mental health, whatever your age and location. If in any situation or for any reason you experience a sense of discomfort/embarrassment, and you wish to use the service, please dial their free phone: 1300 22 4636. For more information visit https://www.beyondblue.org.au

How do I agree to participate in this research?
Completion of the online survey will also indicate your voluntary consent to participate in the study. Participation is voluntary. Once the data has been submitted, it cannot be withdrawn and to withdraw simply close the browser during the survey.

Future use of my data
Research data are a valuable resource, usually requiring much time and money to produce. Your anonymous data, stored for 6 years on the university's network drives will be used only for research purposes to serve various industries and occupations to better support the sport and physical activity of Indian migrants. Information obtained is used only for research purposes and in ways that will maintain anonymity.

If you have any questions, please text/call, or email our primary researcher in Melbourne, Australia.

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, New Zealand, *ethics@aut.ac.nz*, +64 9 921 9999 ext. 6038.

At the end, please retain the downloadable copy of the survey for your reference.

Appendix D. Summary of studies assessing physical activity and sedentary behaviour of Indians in country-of-origin India

Study	Obj	Participants	Measures/analysis	Findings	Comments
Vaz & Bharathi (2004)	Assessed perceptions of the intensity specific PA in urban Indians and determined if perceptions are dependent on age, gender, BMI and actual PA patterns	Convenience sample: Bangalore city N= 782 Females n= 441 Men n= 341 Age categories: 17-70 yrs.	Self- administered questionnaire SPSS (household, discretionary, overall PA)	Age and gender significant interactions with discretionary exercise, overall PA, household for all p= 0.000. No correlation between total PA and BMI No effect of BMI on age and gender perception of intensity <u>Total PA levels Mets/mins/d:</u> least active: >58 yrs: Women:1.30+_0.13 Men: 1.22+_0.07 Most active: Men: ages 17-24yrs: 1.64+_0.21 women: ages 25-35 yrs: 1.56+_0.15 <u>Perceived PA intensity Age and Gender</u> No significant gender differences: walking p=.616 Sign. gender differences: Jogging, uphill walking, manual labour, -women perceived high intensity Household (sweeping, manual washing): men perceived high intensity	Age and gender correlates in perceived intensity of PA. Individual level perceptions of PA needed. Relevant domain specific behaviours crucial in relation to Indian populace age and gender related PA.
Anjana et al., (2014)	Assessed PA patterns across India (part of ICMR-INDIAB STUDY)	N= 14227 Aged: 20 yrs + Urban n= 4173	GPAQ SAS Software Stratified multistage	Overall 54.4% inactive; 31.9% active (58.3% men); 13.7% highly active (61.3% men). <u>No LTPA</u>	Inactive significantly older, high BMI & WC (all p< 0.001); higher average income,

	Rural n= 10054 Tamil Nadu -South, Maharashtra-West, Jharkhand- East, Chandigarh-North,	design sampling One- way ANOVA (inactive, active, highly active) T test, chi-squared test for urban rural comparisons	Tamil Nadu -South: 93% Maharashtra-West: 91%, Jharkhand- East: 95% Chandigarh-North: 88% Transport: greatest- Jharkhand 20min/d. LTPA: 91.9% no recreational; Rural less recreation 93.2% vs urban 88.7% p<0.001 Rural & urban women less LTPA vs. men (urban 94.6% vs 82.7%; rural 97.1% vs 89.3% p < 0.001) Overall < 20min/day MVPA, greatest in Jharkhand, then Chandigarh, Maharashtra, Tamil Nadu. Males more LTPA (exception Chandigarh (not significant) <u>State-wise inactivity:</u> Tamil Nadu -South: 60% Maharashtra-West: 52%, Jharkhand- East: 35% Chandigarh-North: 67% <u>State-wise PA proportion (Rural: urban %)</u> Tamil Nadu -South: 31; 21% Maharashtra-West: 32; 24%, Jharkhand- East: 50; 42% Chandigarh-North: 25; 20% Overall inactivity higher in urban than rural (65% vs 50% p< 0.001). Women more inactive than men (63%; 4509/7156 vs 45.7%: 3228/7071; p <0.001)	upper SES. No recreation with increasing age wise distribution of participants (chi squared: 199.1 p < 0.001 Authors stated “GPAQ may not be culturally specific measure p 9”

Sullivan et al (2011)	Investigated relationship between urban and rural migration and PA	N= 6447 North and South regions Rural, urban, rural-urban residents Ages:17 to 76 years	Interviewer administered socio-demographic questionnaire IMS-PAQ 30 -day habitual PA, Domains: sleep, occupation, exercise, household, hobby, sedentary (sitting, TV), other (travel). Total PA: Mets hr./day STATA	Overall PAL = 1.62 (SD 0.19) equivalent to light active /sedentary. Regional Variations: North regions greater total PA levels, light intensity PA vs. South <u>Sedentary behaviour (SB):</u>Overall majority population time spent = 475min/d majority population sedentary: SB greatest among in rural-urban women followed by urban women, rural-urban men, urban men- least active, rural men- most active Rural: more total PA = 1.69 vs1.58 urban vs. 1.59 urban; rural greater time MVPA mean `142 min/d vs urban 79 mins vs 77 migrant min/d Less sedentary time 421min/d vs 491 min/d rural-urban vs. 508 min/d urban. TV viewing daily less in rural (15 min/d vs. migrant 50 m/d vs. urban 55 min/d Rural men addition hour of MVPA, less Tv (30mins), less hour SB, 15 m/d more sleep vs. rural-urban and urban men.)	Strength: diverse regions IMS -PAQ validated on Indian population Limitation: Selection bias Age and gender correlations
McKay et al., (2015) India & Bangladesh	Examined correlates of socio-demographic variables on active travel (AT) & active travel on adiposity in rural India and Bangladesh	N=2122 Ages: 18+ yrs 2011-2013 Chennai: n= 648 Goa= n= 734 MATLAB: n= 740 (Bangladesh)	GPAQ Sociodemographic lifestyle variable: sex, education, MVPA-Leisure; occupation, household income. Kruskal-Wallis tests for categorical variables	PAL: Low LTPA across all regions 5.9% participated in LTPA, 46% met 150min/wk from AT only, more in Indian regions vs Bangladesh. (Goa 54.8%; Chennai 49.7%, MATLAB 33.1%, p<0.001) Total Time spent on PA level greater in Chennai vs Goa and MATLAB (1285;612;419 m/w p<0.001)	Regional variation in India for active travel with Goa greater than Chennai. At varies between SA groups. Indians more likely to achieve guidelines via OPA than LTPA. Females less likely

	Log regression for 150> min/wk of AT & socio-demographic variables on lifestyle indices+ PA modes	Occupational domain PA greatest in India-Chennai (1011m/wk) vs Bangladesh (175m/w). Correlates of AT: Work related PA more likely to achieve guidelines (150 m/wk+) (OR 1.71, 1.35-2.16 p<0.001) than LTPA (OR 0.96, 0.61-1.53) -not sig. Indian region -Goa (versus Chennai) has greatest PAL via AT (Goa-OR 2.13, 95% CI: 1.59-2.86, p<0.001) (Chennai OR 1.22, CI 0.91-1.63) Women less likely to engage in AT than males (OR 0.25, 0.20-0.31, p<0.001)	to engage in AT than males in this sample.

Appendix E. Summary of global findings specific to Indian migrants (including Australia)

Study & location	Objective	Participants	Methods/ Measures	Findings	Limitations
Hayes et al., 2002 U. K.	PA patterns & relationship to health biomarkers among SA & Europeans	SA Men Indian: n=103, Pakistani: n=158, Bangladeshi: n= 64 SA Females Indian n=146, Pakis n=134, Bangladeshi=53 European (England & Wales) males n=377 Females n= 372 Age: 25-74 yrs.	New castle heart project (1993-1997): Cross sectional population-based questionnaire Measures: Multidimensional index Type: LTPA, daytime activity, walking, cycling, sport & recreation-METs PA Index 0-8 SPSS V8.0	% population not meeting UK guidelines: England & Wales: 51.6% Indian: 71% men; 83% women Pakistani: 88% men; 81% women Bangladeshi: 87% men; 90.8 %women Walking Men % Av weekday <1mile Indian 57%; Pakis 60%, Bang 50%; EU: 32.2% % Av weekend <1mile Indian 61%; Pakis 62.2%, Bang 60.9%; EU: 21.5% Women % Av weekday <1mile Indian 43.5%; Pakis 52.1%, Bangladeshi 48.1%; European:37.3% % Av weekend <1mile	Sample selected by identifying Asian sounding names. U.K. national PA guidelines Questionnaire not validated on Indian population Football and rugby listed one item on questionnaire Culturally representative sample of Indian migrants unknown

Indian 63.4%; Pakis 71.8%, Bangladeshi 48.2%; European 28.2%

Cycling

Men

weekday miles < 2

Indian 3.8; Pakis 0%, Bang 0%; EU: 3.6%

weekend miles < 2

Indian 2.8%; Pakis 0%, Bang 0%; EU: 2.2%

Women

weekday miles <2

Indian 1.9%; Pakis 1.4%, Bang 0%; EU: 2.3%

weekend miles < 2

Indian 4.5%; Pakis 1.4%, Bang 0%; EU: 2.1%

Daytime activity

Men Sitting-not much walking

Indian 44.8%; Pakis 33.3%, Bang 26.6%; EU: 29.1%

Women Sitting-not much walking

Indian 24.8%; Pakis 37.9%, Bang 39.3%; EU: 20.3%

Men standing walking not carrying

				Indian 34.3% Pakis 46.8%, Bang 45.3%; EU: 41.6% Women standing walking not carrying Indian 50.3%; Pakis 48.3%, Bang 51.8%; EU: 51.6%	
Williams et al., 2011 U.K.	Examined LTPA in SA 's versus UK British participants	British N= 8974 SA Subgroups Men Indian: n=806 Bangladeshi: n= 719 Pakistani: n= 850 British: n= 4006 Women Indian: n= 943 Bangladeshi: n= 862 Pakistani n= 965 British: n= 4968 Age: 18-55 yrs Birth country (generational) Men SA UK born: n= 607	Health Survey of England; 1999-2004 Cross sectional Face to face survey LTPA, exercise, household walking Measures: T tests: continuous X^2 tests categorical ANCOVAS- ethnic groups on total MET min/wk + subgroup on total MET mins/wk SPSS 14.0	Subgroups variation by gender (Mean total MET m/w) Men partial n^2 =0.03. Indian = 1089.33 MET m/w; Bangladeshi = 1055.37 Pakistani= 973.84 British= 1672.05 Females: partial n^2 =0.02. Indian = 919.41 Bangladeshi = 775.41 Pakistani= 926.47 British= 1292.67 Birth country (generational) male SA UK born: 1385.23 Born outside UK: 935.53 Female: UK born: 972.50 Born outside UK: 843.66	Survey validated on accelerometer on 106 British adults (45 men) Survey no questions on walking and domestic PA Not all findings specific to Indian migrants Culturally representative sample unknown

		Born outside UK: n=1895 Female: UK born: n= 766 Born outside UK: n=2153			
Misra et al., (2000) U.S. Gujrati Migrants	To assist health promotion behaviours of Asian Indian immigrants in the US.	Gujarati US-migrants 60% of representation of Indian-US populations. N=261 Sampling frame: national Gujarati Association Ages: 18-79 yrs. Mean-46.1 yrs.	Cross sectional Gujarati's SPSS Health promotion lifestyle profile II (Walker et al) 6 domains: health responsibility, PA, nutrition, Spiritual growth, interpersonal relations, stress management. validity reliability established coefficient alphas: health responsibility (.81); physical activity (.84), nutrition Related behaviours (.76), self-actualization (.81), Interpersonal relations (.79), stress management	<u>Significant gender difference for Self-rated health status</u> 89.4% -good-excellent physical health. 13.5%-men; 3.8% women- poor/fair physical health (x^2 =9.41*p*=.05); 40% obese & 74% medical issues. <u>Use of Preventative Health Service</u> 20% participants indicated using alternative medicine adherence. Wellness checks/yr = 48.8%; mainly women (59%) <u>Health promotion behaviours</u> No differences in health promotion behaviours PA – low (mean score = 2.32); **Spiritual growth (mean = 2.88); Interpersonal relationships (mean= 2.82) Women more likely to report across subscales vs. men. Highest Inactivity: age: 25 -50 years; below 25 higher PA participation rates vs. 26-50 & >50 yrs.	-Lack of Indian representative sample [“homogenous”} + participant selection -Use of last name directories not appropriate for the diversity of the Indian population +The author emphasises the regional diversity and cultural & Religion Norms adopted by each regional sub-culture of India.

			(.76). total scale internal consistency (.94).	<u>Gender:</u> Women= increased health responsibility & awareness (TV, reading) vs. Men (*t*=3.64, *P*=<.01) which may explain greater mental & physical health vs. men <u>Immigrant yrs.</u> (note 50% <or =20 yrs) >20 yrs = more PA level; stress management techniques, health responsibility. *<u>Discussion insights:</u>* Distinctions from other CALD migrants include: "Indian have higher family income vs. other ethnic groups". Implication: Health workers need cultural sensitivity to ayurvedic and homeopathic medicine + western medicine to be responsive in multicultural communities. Need for allied health professional education in multicultural competency. + emphasised considering diversity & invisibility of Indian population in planning	
Kalavar et al., 2005 U.S.	**Study 1:** Motives to engage in PA Study 2: Qual added to qual section	**Study** 1: N=100 n=53 men n= 47 Women Older Indian migrants with PA 1 x wk Average age= 73 yrs	**Study 1:** 29-item Participation motivation questionnaire for older adults- reported adequate reliability and validity; Social, fitness, medical, recognition,	**Study 1:** Social, *F* (1, 94) = 4.5, *p* = 0.04; Fitness, *F* (1, 94) = 6.9, *p* = 0.01; Challenge/Benefits, *F* (1, 94) = 6.6, *p* = 0.01; Medical, *F* (1, 94) = 4.8, *p* = 0.03; Involvement, *F* (1, 94) = 17.3, *p* < 0.001. Compared to females, the males rated these factors as significantly more important to	Older migrants

			challenges/benefits, involvement-Modified from PMQ. Multivariate ANOVA	their participation in PA and exercise. no significant difference between males & females Recognition factor.	
Misra et. al., 2005 U.S.	Investigated relationship of intensity, duration of LTPA on health markers	Indian migrants N= 56 Indian men: n= 31 Indian women: n= 25 San Francisco 72% Punjabi 8% Gujarat, 12%Maharashtra 8%Kerala. Ages: 43yrs+_ 7	Cross sectional Face to face survey Only LTPA: Minnesota LTPA questionnaire (AMI-Activity metabolic index score); Taylor Intensity codes-light moderate, heavy-past year yoga, cricket, meditation-additional 'new activities' used (MET's)-compendium of PA; SPSS v.11.0 Descriptive stats (mean, SD) Log transformed LTPA	Total LTPA: 385.9+_ 408 mean AMI/w No LTPA 40% women vs. 10%men Gender: Total LTPA mean AMI/wk; Men 533+_ 445.7 mean AMI/w; Women 203.5+_ 265.5 AMI/wk.; Types of PA: Walking common Walking for leisure: (40% men + 32% women) Occupational PA: during work breaks Other LTPA preferences: Women: cross-country skiing, hiking, mountain biking Men: cycling, swimming, hiking, golf, tennis, volleyball, cricket, basketball.; home repairs, gardening men + women: Household 28%; Exercise: 10.7% health club; take stairs vs. heavy intensity exercise.	Modified original questionnaire which had fewer activities typical to Indian populace. additional 'new activities: yoga, cricket, meditation Valid & Reliability r= 0.88, p<0.5 30days; North American pop

Joseph & Bishop 2015 U.S.	Assess self-report levels of PA in different domains and relationship in self report PA and BMI among Indian migrants	Convenience snowball sample Indian women n=262 ages: 21-60 yrs.	Cross sectional descriptive IPAQ-L: LTPA, OPA, AT, HPA, sitting time x 7days Frequency, d/w, intensity m-hr./w Focus groups for comprehension of instrument. -more example added to LTPA Descriptive stats, Pearson's correlation SPSS v 22.0	Total PA: 103.19 mean total met hr./wk; median score 55.96Met-hr/wk; lowest quintile for PA in all domains Total Sitting time: highest quintile, median 30.50, and 55.96 Type: Total walking: 30.51 mean met hr./wk LTPA: Walking 3.42MET-hr/w Transportation: walking 1.1 Household: gardening 6.72;6.89(moderate) vigourous 1.9 Job-related walking: 25.10 METhr/w	Only women Used median score following IPAQ scoring protocol as more accurate estimate of central tendency to offset skewed scores
Daniel & Wilbur 2013 U.S.	Assessed Lifestyle PA using objective and self-report measures and gender comparison on PA domains	First generation (India-born) N=110 Indian men: n=41 Indian women: n=69	Cross sectional descriptive face to face design Measure of PA: Accelerometer Lifecorder EX(NL2200) 7day LTPA & HPA: CHAMPS Questionnaire 16 OPA's: 12-month Tecumseh Occupational Activity scale.	Average step counts/ day = 6904.3 low active; no sig gender variation Men =41: 7056.6 av steps /d Women n=69; 6813.8 steps/d Proportions meeting national guidelines LTPA-51.8% participants; men 51.2%; women 52.2%; no sig difference. OPA- 57.3% participants; men 65.9%; women 52.2%; no significant difference HPA -20% participants; men 26.8%; women 15.9%; no sig gender difference.	CHAMPS Questionnaires-validated on African communities. reliability (0.62) on African American, Asian American. TOA scale: validity 0.46; reliability 0.73 Caucasian, African American women + Correlation for self-reported measure of PA and objective measure

	light, moderate, vigourous codes	Domain specific -Total Mean mins/wk. LTPA: 462.4 (n=110) HPA: 362.7 (n= 110) OPA: 2420 (N=81) Gender: Mean min/wk Men: LTPA: 381.9 (n=41) HPA: 283.17 (n=41) OPA: 2356.6 (n= 36) Women LTPA: 510.2 (n= 69) HPA: 410.0 (n= 69) OPA: 2470.6 (n=45) PA Domain LTPA: Walking: common: no gender variation 42% women vs 26.8% men Jog run: 29.3% men vs 13% women, $p<0.05$ Other: hiking, yoga, dancing OPA's common: sitting light work, greater number of men walked in OPA	only for all participants in LTPA of a moderate to vigourous intensity r= .201; + all levels of intensity only among Indian women r=.296. Women more in HPA; Selected participants only from religious institutions

				domain than women (51.2% v 26.1% light carry). Average work hours/wk: 40; Indian men 39 h+; women 41hrs/wk: HPA: time spent greater in women 342m/w vs men 147.8 (light-HPA); Gardening: men 135.36 v women 67.60 m/w $p<0.05$; heavy gardening men vs. women 41.5%: 17.4% ($p< 0.01$). no vigourous HPA between men and women.	
Jonnalagadda & Diwan (2002) U.S.	If dietary intake varied on region among first generation Indian migrants	Indian men & women N= 237 (four regions of India) Age: 40 yrs+ (average residence 25 years)	Telephone survey Demographic: sex, income, region of origin (north, south, west, east-excluded small size) STATA; SPSS	BMI varied by region: South 70% PA 3+ activities/wk (PA index) North 56% PA (least PA) (higher BMI-lowest PA) West 65% PA	Need to examine impact of regional differences on morbidity and mortality among Indian migrant populace Limited: non -random sample
Jonnalagadda & Diwan (2005) U.S.	To examine correlates of health behaviours (PA) and self-rated health in middle aged and older Asian Indian migrants	*n*=162 women n=64 50 years+ Av length of residence= 25 y	Telephone survey: demographics, behavioural risk factors, acculturation, perceived control, quality of social support, depression, BMI, chronic disease prevalence, self-rated health	55% participants aerobic activities PA Correlates: Younger age, bicultural or more American assc. Increased PA participation. High income, depression associated with low PA.	Multitude of factors influence PA practice; culturally apt interventions encouraged.

Sinnapah et al., (2009) Guadeloupe	Examine association between ethnicity and PA	Guadeloupean workers *n*= 122 Group 1: N= 60 Asian Indian Males n= 27 Females n= 30 Group 2: control N= 57 (African, Caribbean Islanders). Males n= 25 females n= 32 Age: 17 to 66 years	PAL index of PA – equation based (EE/BMR); Reported EE kcal: compendium of PA 24 Hr. recall log of activities STAT view software v 4.57. No domain	PAL: Asian Indian low daily PA versus general pop Group 1: PAL Males: 1.45+_0.12; Females: 1.62+_0.22 EE Males: 2615+_417; Females: 2264+-465 Group 2 PAL: Males: 1.64+_0.33; females:1.74+_0.34 EE: Males: 2921+_608; females: 2481+_627 Asian Indian increased sedentary Inferred impact of culturally inherited lifestyles (sociocultural factors) Ethnicity, gender effects significant on EE and PA influences/correlation performed	Not designed to explain difference in behaviours. Selection bias: Factory workers recruited from one medical center who attend annual medical check up
Mahajan & Bermingham (2004) Australia	Examined Anthropometric, behavioural & biochemical risk factors for CHD and diabetes in Indian population	<u>Grp 1- Indians living in India</u> India residents 125 subjects (82 men and 43 women)	Comparative research methodology PA, Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C) and triglyceride (TG) concentrations	Total PA, p=0.07 <u>Grp 1- Indians living in India</u> Total PA: 23.7+_ 32.7 hr./2w; Women: 33.5+_36.9 hr./2w p<0.001) Men: 18.9+_29.4 hr./2w Walking:	No objective measures Mainly cardiovascular diseases aimed over PA data Other factors not explored

		Grp 2- Indian living in Sydney, Aus Australian-Indian residents n= 125 (68 men and 57 women)		Women 9.2+_9.18 hrs./2 wk (P<0.01) Men: 5.8+_9.4 hr./2wk Grp 2- Indian living in Sydney, Aus Total PA: 17.2+_23.2hr/2w Women: 17.1+_20.6 hr./2w (p<0.001) Men :17.3+_25.5 hr./2w Walking: Women: 4.8+_5.3hrs/2 wk (P<0.01) Men: 4.3+_6.3 hr./2wk -Little difference in walking habits in men of both the populations. -women in India more active; significantly more time walking compared Australia (9.279.1 vs 4.875.3, P=.003)	No correlates
Fernandez et al., (2015) Australia- City unknown	To assess the CHD risk factors in the Indian community in a large city of Australia	Self-identified Indian migrant attending the self-promotion activity at the Australia India friendship fair 2010 Ages: 18-80 yrs English speakers	Exercise habits: Active Australia survey -2000 Self-administered demographic questionnaire SPSS v17	Total PA: Low PA: 65% men & 71% women; 73% not meeting guidelines 37% met guidelines >150 mins (n= 42) Total time spent walking: 20 min -20hrs Walked for leisure/travel	Previous week data Only walking reported

		N= 169 Men: 68 (40.2%) Women: 101 (59.8%)			
Kolt et al., (2007) New Zealand	Assessing body fatness, PA, and nutritional behaviours.	Asian Indians in New Zealand *n* = 112 Male *n* = 50 Female *n* = 62 Ages: 44-91 yrs.	Pedometers were worn to record daily steps.	Low PA levels (5,977 ± 3,560 steps/day) significantly different between males (6,982 ± 4,426) and females (5,159 ± 2,401) Barriers: Lack of understanding. Need for support.	51, months average length of residence
Sarkar et al., (2017) U.K.	To investigate intergenerational PA level among 1st & 2nd generation Sikh Punjabi men from two Sikh temples in Medway, UK.	Sikh Punjabi male *n* = 137 Ages= 20-60 yrs.	GPAQ – 3 PA domains Occupational vigorous [v] Occupational moderate [m] recreational, Travel + sleeping & sitting 16 questions Excel, SPSS, Z-test (intergenerational differences)	<u>Total MET-m/w</u> 21-25 yrs.=670.0 [BMI = 30.68 (1.41); 46-50 yrs.= 498.7 [bmi= 28.32 (0.64)] * <u>PA Mean MET-m/w</u> *Occupational V*: 26-30 yrs. [70.3 (145.3)];51-55 yrs. [00.00] *Occupational M:* 41-45yrs [112.17 (180.28)] *Recreational V:* 21-25 yrs. [220.0 (244.95)]; 51-55yrs.[00.00] *Recreational M*:36-40 yrs. 303.87 (208.39) Travel: 51-55 yrs. [295.0 (224.7)] <u>TDEE Kcal/d</u> *Occupational V:* 26-30 yrs.= 98.31 (204.11); 51-55yrs. = 0.00 *Occupational M:*31-35 yrs= 281.63 (454.00) *Recreational V: 21-25 yrs.=* 342.97(388.18); 51-55 yrs.= 0.00	-Generational Criteria unknown -men only -single sub-culture +* most participants w low BMI yet mainly sedentary perpetuating greater risk of CVD. +21-30 mostly VPA + highest sedentary time sleeping + sitting. 51-55 no engagement in VPA for either leisure /work w lowest mean time for sedentary activities.

				Recreational M: 36-40 yrs.= 610.11 (342.88) Travel: 51-55 yrs. = 649.49 (253.71) Sleeping mean: 21-25 yrs.= 691.35 (68.84); 51-55 yrs. =532.63 (73.86) lowest Sitting mean: 21-25 yrs.= 1255.80 (97.84) ;51-55 yrs.= 1074.45 (66.80) Irrespective of generation all participants mainly have sedentary jobs (are sedentary) with low PAL, EE compared to Highlights PA due to transport (e.g., walking, cycling to and from work) is likely to be much higher in India than among their counterparts in the UK	+ migration impact on Punjabi occupation + need studies on facilitators PA
Joseph, Hanneman, & Bishop 2019 Texas	To examine the r/nps among PA, acculturation & Immigrant status across three PA domains (occupational, household, and leisure) & SB.	Indian women *n* = 262 Convenience + Snowball 21–60 y <u>Immigrant India-born</u> High accul: n=41 (16%), Low accult:	IPAQ-L (Craig et al., 2003). Total PA = HPA, OPA, LTPA <u>Acculturation</u> Suinn-Lew Asian Identity Acculturation Scale (<u>M</u>-SL-ASIA). (Suinn, Ahuna, & Khoo, 1992). <u>Physical functioning</u> physical functioning subscale (PF-10) of RAND 36-Item Health Survey	Household income not sig between immigrant groups. But sig differences for all other demographic variables (age, graduate degree, partnered, yrs. in US, employed,) <u>Low acculturation women (high Asian identity)</u> Highest OPA, HPA, Total PA (59.8:14:102 vs 3.30; 9; 34.70 median METhrs/wk) <u>High Asian identity</u> greater PA MET scores than high American identity but no sig difference between immigrant and non-	Preferences were paper survey and online survey links. - greater proportion of students comprised the high acculturation sample of immigrant and non-immigrant Indian women confound the findings.

		n = 123 (47%) Non-immig US-Born High accul: *n* = 97 (37%) low accul: *n* =1	(Hays, Sherbourne, & Mazel, 1995). Chi-square, Kruskal-Wallis H test, One-way ANOVA, Tukey, Mann-Whitney post hoc	immigrant high American/Asian women. Suggesting OPA and HPA closely linked to identity than immigrant status. High acculturation women (high America identity) Highest LTPA and SB (6.60;34.12. vs 0.00; 26.84 median MET hrs/wk.). More SB in Indian women with American identity. Among Indian migrant women - Level of Acculturation (cultural orientation) may be assctd w type of PA (opa, household, LTPA, SB) irrespective of either being born in the western country or had migrated to the adopted western country.	Future research: consider seasonal-climate and culture changes and PA
Fernandez et al., (2015) Australia	To review data from the WHOSIS relating to CHD prevalence risk factors between Indians & Australians 2) compare data with published epidemiological studies of CHD risk factors in adult Indian migrants for comprehensive & comparable assessment of risk factors relating	Database WHOSIS Indicator: BMI, Cholesterol, PA, tobacco, diabetes Integrative review MEDLINE, EMBASE, CINAHL, Cochrane 1985+ Indian migrants 18+	Descriptive comparative study Integrative review India, Australia, Indian migrants WHOSIS Australia Self-report-glucose level WHOSIS India All factors except smoking-Biophysical measurement	WHOSIS Life expectancy at birth Indians 64; Australia 81 yrs. CHD related Mortality 1.1 - 4 times higher in Indians vs. host + CALD CHD risk factors *Obesity rate:* India 2%; Australia 30%; 75% prevalence in Australians 20% as Indian migrants. BMI: India 21.7kg/m^2 ;Australia 27.5kg/m^2	+Obesity Prevalence: lower in Indian vs Caucasian [4.2%;22% enas] Overweight individuals greater among Indians vs. Chinese [34 to 47% ;20 to 38% , p<0.05 oz-frank 2009] + low BMI, significantly low obesity, mean cholesterol in India vs Aus, these rates are higher among Indian migrants for two reasons: dietary acculturation; cut off

to CHD and mortality attributed to these risk factors		Cholesterol levels: India 5.2 mmol/L Australia 5.5 ; prevalence rates for hypercholesterolemia Indian migrants 18.5%; greater for Indian women vs Caucasian (8.3% vs 4.1%, p=0.02 Enas-1996] <u>Hypertension</u> India men vs Australian men [124.4 mmhg;118.2 mmHg] Lower in Indian women vs Australian women [11.3% 11.4% enas96] raised blood pressure lower in India vs Australia [10.5% 18.8%] **Physical inactivity** % Australians 34% Indian data unavailable; mean met min/week 8103.6 (135.06 hrs/wk); Females less active <u>not meet PA Guidelines</u> Indian migrant men 71% European men 52% [Hayes] Indian 67% Caucasian 59.3% p=0.004 [Mohanty 2005] <u>total activity (AMI/wk)</u> Indians men 533 vs Caucasians 204? (Mishra 2005)	points BMI used in India not tailored for Indians, as Indians have higher fat % with low BMI. Raised cholesterol higher in Indians due to measurement variations by country. Lower incidence for CHD risk factors than Australians. But Indian migrants higher prevalence for inactivity, obesity, diabetes-reasons are multifactorial -healthy migrant effect, gene-environment interplay, culturally underserved healthcare environments for migrant. + author emphasised need for perspective from Indian migrants for informing health information/policy.

Appendix F. Summary of correlates of physical activity from cross-sectional studies on Indian migrants

Study	Country	Design	Sample	Findings
Jonnalagadda & Diwan (2005)	U.S.	Cross-sectional	Indian migrants in U.S (average residence 25 years) *n* = 226; 162 men and 64 women Ages: 50 + years	Younger age, longer length of residence and a bicultural or more American ethnic identity were associated with greater PA
Kolt at al., (2007)	New Zealand	Cross-sectional	South Asian in New Zealand (average residence 51 months) *n* = 112 Men *n* = 50 Women *n* = 62 Ages: 44-91 yrs.	Length of residence associated with PA.
Sinnapah et al., (2009)	Guadeloupe	Cross sectional	Indian migrants in Guadeloupe (length of residence unknown) *n* = 60 Ages: 17 to 66 years	Ethnicity = ↓ EE Ethnicity = low PA

Appendix G. Summary of correlates of physical activity from cross-sectional studies on Indian migrants

Correlate	Study	Location	Statistical analysis	- (less PA)	0 (no association)	+ (more PA)
Age	Jonnalagadda & Diwan (2005)	U.S.	Multiple regression coefficient	Increased age p <0.0014	-	-
Greater length of residence	Jonnalagadda & Diwan (2005)	U.S.	Multiple regression coefficient	-	-	r = 0.09
	Kolt et al., (2007)	New-Zealand	Pearson' s correlation Partial r (age, sex)	r = -0.23 p= 0.02 r = -0.19 p= 0.05	-	-
Ethnic identity	Jonnalagadda & Diwan., (2005)	U.S.	Multiple regression coefficient			Bicultural & more American r = 0.39
Ethnicity	Sinnapah et al., (2009)	Guadeloupe	Two-way ANOVA	p = 0.003		

Appendix H. Checklists

Checklist A – Research experts

Exploring The Contexts and Experiences of Sport and Physical Activity Before and After Migration Among Indian Migrants in Melbourne, Australia

Thanks for taking part in reviewing the survey. This checklist will help guide your review and feedback on the overall survey content, design, and process. Before your review, kindly ensure that you have read the information sheet and had any queries answered by the primary researcher. Please also ensure you have read and signed the consent form.

You may choose to note our feedback with the checklist below as follows:
Review the survey against the criterion provided in the first column. Select '**yes**' or '**no**' for each of the ten statements. Note any specific feedback you may want to discuss for your response, particularly for 'no'. An additional sheet is provided at the end of the checklist.

Review Criterion	YES	NO	COMMENTS
Design			
1. The survey question will ask for information a person from the Indian community is likely to know or have access to the information needed.			
2. The survey is focused on the participants and participants' experiences.			
Wording			
3. Questions/responses are written in simple language.			
4. Question/response wording reflects the language and culture of respondents.			
5. Questions are specific enough for respondents to know exactly what information is being requested.			
Instructions and contextual cues			
6. The survey includes the necessary instructions to make it easy to answer the questions.			
7. Explanations are included for any terms that might require clarification.			

Demographic questions and network instrument

8. Provide a deep understanding of and respect for the participants.
9. Survey questions use terminology appropriate for the people belonging to the Indian community.
10. Survey response options reflect all desired respondents [that is, respondents can see themselves in the options] and avoid the use of the term other

Use this space only if you have any further comments, suggestions, or feedback you would like to share (Max 300 words limit)

Checklist B: Cultural representatives

Exploring The Contexts and Experiences of Sport and Physical Activity Before and After Migration Among Indian Migrants in Melbourne, Australia

This checklist will help guide your review and feedback on the overall survey content and process. Before your review, kindly ensure that you have read the study information screen and had any queries answered by the primary researcher.

"Please review the survey against the criterion provided in the first column on its content and the overall process. For each of the fifteen statements, select 'yes' or 'no'. You may choose to note any specific feedback you may want to discuss later for your chosen response, particularly if you selected 'no'. An additional response sheet is provided at the end of this checklist".

Review Criteria	YES	NO	COMMENTS
Content			
1. Question/s ask for information I as a person from the Indian community would likely know or have access to the information needed.			
2. The instructions provided for each sub-section are clear and easily understood.			
3. My response to each question is captured within the response options provided.			
4. I had no trouble understanding the meaning of any of the questions.			
5. The order of questions is appropriate to my responses provided i.e. I was not directed to a question that was irrelevant to my previous response.			
6. The wording of the questions/response options is appropriate and respectful to the people of the Indian community.			
Process			
7. Invitations received in the manner intended (Good, poor)			
8. Information sheets are easily understood and contain an adequate level of detail on the study process and the participant's role in it is clearly described.			
9. The consent form clearly outlines the key information a participant in this study should be aware of/reminded of.			
10. The estimated timeline (30 minutes) to complete the survey is appropriate.			

11. The estimated timeline (15 minutes) to read the instructions and provide consent is adequate.
12. Incentives are appropriate for the time and value participants provide in completing their survey.
13. The online survey was easy to complete with no difficulty.
14. The survey was interesting making me think of my PA and sports habits before and after migration.
15. I felt encouraged/motivated to complete this survey.

Suggestions

Are there any challenges you anticipate individuals from the Indian community in Australia taking this survey may experience? Please include your suggestions on how to mitigate these challenges. (Max 500 words limit)

Additional space below is provided if you have any further comments/feedback you would like to share (Max 300 words limit)

Appendix I. Iterative survey refinements – Exemplifying survey revisions following online external review, independent feedback sessions, and cognitive interviews

Table A. *Revisions to the initial survey draft following the external review of the online survey using structured checklists.*

Checklist Criterion	Checklist Item/Description	Written Comments from Experts	Survey Changes/Considerations
Instruction and Contextual cues	Explanations are included for any questions that require clarification.	*"I think so, but again, I'm not an expert on Indian culture or people who speak a language other than English. There may be some people who find terms difficult. It would be good to check with someone about this"* R1.	Inclusion of two research experts from Indian backgrounds in pre-testing the survey.
Network Instrument	Formatting	*"Reword:* *First, think about (Name 1), and (Name 2), Are they total strangers?"* R3	Revised as: *To your best knowledge:* *Does (Name 1), know (Name 2)?*
	No. of alters	*"If possible, to Increase alters to more than 5?"* R3	Considerations to increase no. of people the participant nominates
	Nominating people in the participant's network	Research Expert 1: *"Assumes participants have up to 5 people to join in PA or Sport. This may not be the case".* R1 Research Expert 2: *I was a bit annoyed that it forced me to list 5 people that I recreate with when I am a solo gym goer and dog walker - but quite social otherwise, R2.* Research Expert 5 [Indian background]: *"What if we didn't do any activity with 5 people? It is not allowing us to move on – I now have to enter false initials to keep moving to the next one." (CR5)*	Considerations on how to screen participants who may or may not qualify to take the network analysis component
Design	Wording	Language consistency: either Physical recreation or physical activity. R4	Revised to "physical activity" throughout.

		Consider adding ‘average’ minutes/day - not everyone does the same amount each day”. R4	Added 'average' minutes/day for frequency and duration columns/questions
	Response stem	Gender - add “prefer not to say”. CR2	Added "prefer not to say”
Process	Timeframe	“Straightforward and easy” to complete within the recommended time frame. C6	None.
Additional feedback	Anonymize survey	Research expert 5 [Indian background]: “Why are personal details required for this study? Some people may opt-out at this stage – I suggest you don’t collect this unless absolutely necessary and make it clear why. …. After completing the survey, I realized that you didn’t need my personal details at all – so, again, consider not asking this.”	Consideration to transition to an anonymous survey

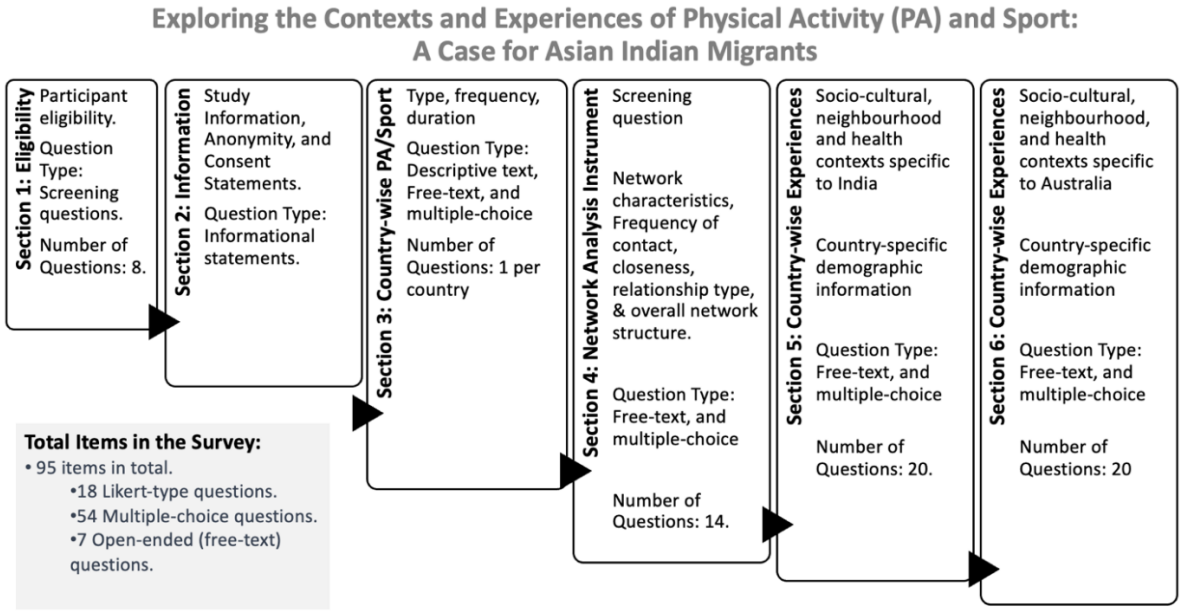
Table B. *Examples of survey revisions after feedback received from the independent feedback sessions.*

Category	Discussion	Consensus	Survey Revision
Network instrument	Nominating people in the participant's network	Addition of a screening question	Please identify the likely maximum number of people you often join to take part in sports or physical activity in Australia'
	Considering additional behavioural questions	Addition of the type, frequency and duration of PA and sport of individuals the participant nominates	Examples: To your best knowledge, estimate: - On average, how many minutes do you think this person engages in sport/physical activity in a typical day? - On average, how many days do you think this person engages in sport/physical activity in a typical week?
Anonymous Survey	The transition from written consent to implied consent	Removal of personal details	Items deleted: postcode, contact phone, Full name, and signature

Table C. *Example of the survey items tested with cognitive interviews.*

Survey Item	Probe Question	Respondent's 'Think-aloud' Response
List sport/PA. *Note*: Item listing the participant's type of PA/Sport	"How did you know what to consider as a sport and what to list for PA?"	For sport – "selected activities designated around the actual sport". For PA consider – "gardening, walking, household work, [with the thought] as long as you are active", C7 [British born second generation Indian migrant]
'I am one with [India/Australia]' *Note*: This item is within a scale that assesses cultural identity.	"What do you understand by 'I am one with [India/Australia]?"	"I think it's about being patriotic perspective on culture, values, religion" C3 [First generation Indian migrant]
"There is a close-knit neighborhood – [India/Australia] *Note:* This item is within a scale that assesses neighborhood social cohesion.	"Why did you select No"	".. [I have] traveled for work over 40 years to India where extended family lives. People [neighbors] know each other there …. I'm by myself here [in Australia] for 10 years with my wife's family. I have to build up a network, no blood ties or childhood friends. So, it is different in terms of the relationship. So, not that level of closeness [with neighbors]. C7 [British born second generation Indian migrant]
Name generator - Sport & PA. *Note:* this item is within the network analysis instrument.	"How did you come up with the names you listed as your answer?"	"I selected the people I most often interact with in order to take part in sport or a physical activity", C6 [Indian-born second-generation Indian migrant]
Ego-Alter Closeness *Note*: this item is part of the network analysis instrument	"What to you is 'closeness'?"	"Strong personal relationship with, or professional relationship with. Not somewhat close", C7 [British born second generation Indian migrant]

Appendix J. Illustration depicting the structure of the final survey, outlining the arrangement of sections and question types



Appendix K. The final survey

Exploring the Contexts and Experiences of Sport and Physical Activity Before and After Migration among Indian Migrants in Australia



THIS SURVEY IS ANONYMOUS

ELIGIBILITY

Completing these questions will determine if you are eligible to take part in this survey.

How old are you?
17 years or younger
18 years
19 years
20 years
21 years >70 years

Where were you born?
India
Australia
Another Country - Please state

Select your **birth state in India**.
Andhra Pradesh
Arunachal Pradesh
Assam

Bihar >….

Select the most appropriate option below that best considers your **length of stay in India**.
I lived/stayed in India less than one year
I lived/stayed in India for at least one year
I never lived/stayed in India

At what **age did you move to Australia?**
Before 12 years of age
After 12 years of age

Do you have **at least one parent who was born in India?**
Yes
No

How many **years** have **you lived in Australia**?
Less than 1 year
More than 1 year

For how many **years** do **you intend to live in Australia**?
Less than 1 year
More than 1 year

SPORTS AND PHYSICAL ACTIVITY

In this section, we ask about your time spent on different types of recreational sports and physical activity in India and Australia.

Please answer these questions even if you do not consider yourself to be a physically active person.

Include activities even if you've only done them once or twice in the last year.

INDIA

"Please name what sport or physical activity you took part in **when staying/living in India.** You have the **option to name up to 10 different activities**. Recall approximately **how many times** and the **duration** you took part in each activity. Start with the one you spent the most time doing".

Example below:

Activity/Sport	**Day(s)/week (average)**	**Minutes/day (average)**
Badminton	4 days/week	60 mins/day

	Days/week (Average)	Minutes/day (Average)
1. Enter the sport or physical activity you spent the most time doing **in India**		
2.		
3		
4		
5		

AUSTRALIA

"In Australia, name what sport or physical activity you took part in **over the last 12 months.** You have the **option to name up to 10 different activities**. Recall **how many times** you took part in each activity and the **duration** of the most recent occasion. Start with the one you spent the most time doing".

Example below:

Activity/Sport	**Day(s)/week (average)**	**Minutes/day (average)**
Yoga	4 days/week	60 mins/day

	Days/week (average)	**Minutes/day** (average)
1. Enter the sport or physical activity you spent the most time doing **in Australia**		
2.		
3		
4		
5		

PRE-MIGRATION
SOCIAL AND CULTURAL EXPERIENCES
INDIA

CULTURAL FUSION

Please **select one option** that best reflects your connection to India.

Note: Consider your feelings about the cultural, emotional, or national aspects.

I am one with **India.**
I feel immersed in **India.**
I have a deep emotional bond with **India**

I'll do for **India** more than any of the other group members would do
I am strong because of **India**
I make **India** strong

Strongly Disagree > Disagree > Somewhat Disagree > Neither Agree nor Disagree > Somewhat Agree > Agree > Strongly Agree

NEIGHBOURHOOD CONTEXTS

Research shows that where people live can greatly affect their physical activity, but there is a lack of information on the neighbourhood contexts of Indian migrants

---

Based on your neighbourhood experiences in India, rate how much you agree or disagree with the following statements:

In India, there was a close-knit neighbourhood
Strongly Disagree > Disagree > Neither Disagree nor Agree > Agree > Strongly Agree

In India, people in your neighbourhood could be trusted
Strongly Disagree > Disagree > Neither Disagree nor Agree > Agree > Strongly Agree

In India, people in your neighbourhood generally didn't get along with one another
Strongly Agree > Agree > Neither Agree nor Disagree > Disagree > Strongly Disagree

In India, people in your neighbourhood did not share the same values
Strongly Agree > Agree > Neither Agree nor Disagree > Disagree > Strongly Disagree

In India, people around your neighbourhood were willing to help their neighbours.
Strongly Disagree > Disagree > Neither Disagree nor Agree > Agree > Strongly Agree

In India, how often did you and people in your neighbourhood do favours for each other?
Never > Rarely > Sometimes > Often

In India, you could count on adults in your neighbourhood to watch out that children are safe and do not get in trouble.
Strongly Disagree >Disagree >Neither Disagree nor Agree > Agree >Strongly Agree

In India, could your neighbours be counted on to intervene in various ways if:
If children were skipping school, how likely neighbours would do something about it?
If children were spray painting graffiti on a local building, how likely is it
that your neighbours would do something about it?
If a child was showing disrespect to an adult, how likely was it that people in your neighbourhood would scold that child?
Very > Unlikely > Unlikely nor Likely > Likely

In India, when a neighbour was not at home, how often did you and other neighbours watch over their property?
Never Rarely > Sometimes > Often

In India, how often did you and other people in the neighbourhood ask each other for advice about personal things such as child rearing or job openings?
Never > Rarely > Sometimes > Often

In India, in any 12-month time-frame, did you participate in a neighbourhood or block organisation meeting?

No
Yes

In India, about how many adults did you recognise or know by sight in your neighbourhood—would you say you recognised no adults, a few, many, or most?

No adults > Few adults > Many adults > Most adults

In India, in any 30-day timeframe, how many of your neighbours would you have talked with for 10 minutes or more?

None of my neighbours > 1 or 2 neighbours > 3 to 5 Neighbours > 6 or more neighbours

In India, think about the neighbour you were friendliest with. How close did you feel you were to this neighbour?

Close friends >Often keep contact >Sometimes close and keep contact > Acquaintance, seldom keep contact > Didn't know neighbours or didn't have any contact

In India, how many of your friends lived in your neighbourhood?

None of my friends
Few (1 or 2) friends
Many (3 to 5) friends
Most (6) or all friends

HEALTH COMMUNICATION

Questions in this section are on health messaging influences of decisions/choices to take part in physical activity.

In India, have you ever been provided with physical activity advice or recommendations by a health professional?

Yes, in a 12-month timeframe
Yes, not within a 12- month timeframe
No, never.

In India, who provided you with this advice? (Select **all** that apply)

A general practitioner
A personal trainer'
An exercise physiologist'
A physiotherapist'
A nurse'
If other - Please specify

In India, what type of physical activity did the health professional recommend you participate in? (Select **all** that apply)

Aerobic activity
Resistance based activity
Flexibility exercises
Balance exercises
Nothing specific
Can't remember.

In India, did the health professional recommend that you participate in a specific amount of exercise?
Yes
No
Can't remember

Please describe the amount recommended.
'e.g., 30 minutes each day for 5 days/week'

Population Attributes

Why do we need population attributes?
India is a multi-ethnic country. Ethnic knowledge ensures that we include and meet the needs of India's diverse ethnic community. This knowledge could broaden the research impact. It can help identify terminology that best represents Indian people in Western societies. Such information is only used for research purposes relevant to this research study. It is not shared with any external parties and will not disadvantage you in any way. For this purpose, please consider the following:

Enter the **Indian sub-regional background/heritage** you identify with.
For example, Gujarati, or Malayali, or Tamilian, ...

Select your **length of residence in India**.
1 to 5 years
6 to 10 years
11 to 15 years
more than 20 years

Select your **occupational status in India**.
If 'student' and 'employed' select both.
Student > Unemployed > Employed - please enter your occupation > Other: Specify

In India, were you a **member** of a sport or recreational club/organisation?
Yes
No

POST MIGRATION
SOCIAL AND CULTURAL EXPERIENCES
AUSTRALIA

Please **select one option** that best reflects your connection to Australia. Note: Consider your feelings about the cultural, emotional, or national aspects.

I am one with **Australia**
I feel immersed **in Australia**
I have a deep emotional bond **with Australia**
ll do for **Australia** more than any of the other group members would do
I am strong because of **Australia**
I make **Australia** strong

NEIGHBOURHOOD CONTEXTS

Think of your neighbourhood experiences, and rate how much you agree or disagree with the following statements:

In Australia, there is a close-knit neighbourhood
In Australia, people in your neighbourhood can be trusted
In Australia, people in your neighbourhood generally don't get along with one another
In Australia, people in your neighbourhood do not share the same values
In Australia, people around your neighbourhood are willing to help their neighbours.
In Australia, how often do you and people in your neighbourhood do favours for each
In Australia, you can count on adults in your neighbourhood to watch out that children are safe and do not get in trouble.

In Australia, could your neighbours be counted on to intervene in various ways if:

If children were skipping school, how likely neighbours would do something about it?
If children were spray painting graffiti on a local building, how likely is it that your neighbours would do something about it?
If a child was showing disrespect to an adult, how likely is it that people in your neighborhood would scold that child?

In Australia, when a neighbour is not at home, how often did you and other neighbours watch over their property?

In Australia, how often did you and other people in your neighbourhood ask each other for advice about personal things such as child rearing or job openings?

In Australia, in the past 12 months**,** have you participated your neighbourhood or block organisation meeting?

In Australia, about how many adults do you recognise or know by sight in your neighbourhood—would you say you recognise no adults, a few, many, or most?

In Australia, in the past 30 days, how many of your neighbours have you talked with for 10 minutes or more?

In Australia, think about the neighbour you are friendliest with. How close do you feel you are to this neighbour?

In Australia, how many of your friends live in your neighbourhood?

HEALTH COMMUNICATION

Questions in this section are on health messaging influences of decisions/choices to take part in physical activity

---

In Australia, have you ever been provided with physical activity advice or recommendations by a health professional?

Yes, in the past 12 months
Yes, not within the past 12 months
No, never

In Australia, who provided you with this advice? (Select **all** that apply)

A general practitioner

A personal trainer
An exercise physiologist
A physiotherapist
A nurse
Other - Please specify

In Australia, what type of physical activity did the health professional recommend you participate in? (Select **all** that apply)

Aerobic activity
Resistance based activity
Flexibility exercises
Balance exercises
Nothing specific
Can't remember

In Australia, did the health professional recommend that you participate in a specific amount of exercise?

Yes
No
Can't remember

Please describe the amount recommended. 'e.g. 30 minutes a day for 5 days/week'

Post Migration - Attributes

Select your **length of residence in Australia**.

1 to 5 years
6 to 10 years
11 to 15 years
more than 20 years

Select your **occupational status in Australia**.
(If 'student' and 'employed' select both)

Student Unemployed
Employed - Please state your occupation
Other: Specify

In Australia, are you a **member** of a sports or recreational club or organisation?

Yes
No

Select your preferred **gender** identity.
Male > Female > Gender Diverse > Prefer not to say

Thank you for completing this survey.

Yes, I would like to enter the draw
No, I would not like to enter the draw

END

Appendix L. STROBE statement – Checklist of items for the reporting of the cross-sectional study described in Chapter 7

	Item No	Recommendation	Within Chapter Section/Subsection
Title	1	Indicate the study's design with a commonly used term in the title or the abstract	Chapter title
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction, para 1 and 2
Objectives	3	State-specific objectives, including any prespecified hypotheses	Introduction, para 2
Methods			
Study design	4	Present key elements of study design early in the paper	Methods: study design and setting section
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods: study design and setting section
Participants	6	(*a*) Give the eligibility criteria and the sources and methods of selection of participants	Methods: participants sections
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods: measures sections para 1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods: measures sections para 2-6
Bias	9	Describe any efforts to address potential sources of bias	Discussion: Limitations section
Study size	10	Explain how the study size was arrived at	Methods: participants section, para 1
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods: Statistical methods, para 2-8; Appendix M
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Methods: Statistical methods, para 2-8; Appendix N
		(*b*) Describe any methods used to examine subgroups and interactions	Methods: Statistical methods, para 2-8; Appendix M

		(*c*) Explain how missing data were addressed	Methods: Statistical methods, para 1
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Results: Figure 10
		(b) Give reasons for non-participation at each stage	Figure 10
		(c) Consider use of a flow diagram	Figure 10
Descriptive data	14*	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	Results: Table 11, para 1
		(b) Indicate number of participants with missing data for each variable of interest	Titles for tables include number of participants (no missing data included)
Outcome data	15*	Report numbers of outcome events or summary measures	Results: Table 12, Table 13, Table 14
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results: Appendix Results: Table 12 unadjusted, Table 13 adjusted; para 3-4
		(*b*) Report category boundaries when continuous variables were categorized	Results: Table 13 and table 14 regressions, para 3 and 4
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results concerning study objectives	Discussion: para 1
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion: Limitation section
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses,	Discussion: para 1-8 (all para); conclusion section

		results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion including Limitations and future research section
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org. This checklist is taken from von Elm et al. (2008).

Appendix M. Categories for the type of participation, activity focus

Summary of Categories				
Type of Participation			Activity Focus	
Team Sports	Individual Sports	Cultural	Aerobic Activities	Muscle Strengthening
Cricket	Running	Kabaddi	Running	Strength Training
Soccer	Walking	Yoga	Walking	Gym
Volleyball	Swimming	Farming	Dance	Weightlifting
Throwball	Skating	Physical Education	Tennis	Calisthenics
Basketball	Cycling	School Marching	Swimming	Yoga
Hockey	H.I.I. T		H.I.I. T	CrossFit
Roller Hockey	Dance		Badminton	Body Balance (flexibility)
Tennis	Weight Training		Cycling	Pilates
Badminton	Home-based Exercise		Gym - Cardio	Gym Classes
Zumba (group)	Martial Arts		Golf	Home-Based Exercises
Body balance (group)	Weightlifting		Table	
CrossFit (group)	Calisthenics		Tennis	Flexibility
	Stretching		Volleyball	Stretching (flexibility)
	Athletics		Treadmill	
	Karate		Karate	Unknown/Unspecified
	Wrestling		School Marching	Exercising
	Trekking		Athletics	Farming
	Aerobics		Physical Education	
	Exercising		Farming	Other
	Taekwondo		Taekwondo	Meditation
	Pilates		Martial Arts	
	Golf		Cross Country	
	Cross Country			

Appendix N. Summary of results for all variables included in the unadjusted model

	Unadjusted Standardised Coefficient	95% Confidence Interval	*p*	R^2
Age	3.50	0.93, 6.07	**0.008**	0.085
Physical Activity Levels (PAL)				
Pre PAL	-0.79	-0.94, -0.64	**< 0.001***	0.576
Post PAL	0.58	0.28, 0.88	**< 0.001**	0.157
Fusion Identity				
Change in total fusion identity	3.66	0.08, 7.23	**0.045**	0.050
Change in feelings of connection	4.70	-1.49, 10.90	0.135	0.028
Change in reciprocal strength	7.71	0.82, 14.60	0.029	0.059
Social Cohesion				
Change in social cohesion	10.85	4.15, 17.54	**0.002**	0.116
Pre-social cohesion	-15.97	-25.38, -6.55	0.001 *	0.126
Post-social cohesion	6.71	-4.08, 17.49	0.219	0.019
Social Support				
Change in social support	25.612	10.39, 40.84	**0.001**	0.126
Pre-social support	-41.25	-63.47, -19.03	< 0.001*	0.147
Post-social support	24.13	-1.37, 49.63	0.063	0.043
Social Control				
Change in social control	7.35	1.66, 13.04	**0.012**	0.077
Pre-social control	-11.02	-21.45, -0.58	0.039*	0.053
Post-social control	7.19	-0.59, 14.98	0.069	0.041
Social Leverage				
Change in social leverage	12.59	-16.05, 41.24	0.384	0.010
Pre-social leverage	-11.14	-45.86, 23.58	0.525	0.005
Post-social leverage	10.11	-30.85, 51.07	0.624	0.003
Individual-level Neighbourhood Attachment				
Change in individual-level neighbourhood attachment	12.37	4.86, 19.87	**0.002**	0.120
Pre-individual-level neighbourhood attachment	-19.16	-29.78, -8.54	< 0.001*	0.140
Post individual-level neighbourhood attachment	6.48	-5.16, 18.12	0.271	0.015

Length of Residence (Pre)				
15 years or more	-27.36	-143.38, 88.66	0.640	
11 to 15 years	-136.33	-271.91, -0.74	**0.049**	0.156
6 to 10 years	219.11	-2.29, 440.52	0.052	
1 to 5 years	Empty 0.89	-109.81, 111.59	0.987	
Length of Residence (Post)				
15 years or more	101.82	17.66, 185.98	**0.018**	
11 to 15 years	95.07	8.97, 181.17	**0.031**	0.085
6 to 10 years	76.20	-18.30, 170.70	0.112	
1 to 5 years	Empty (-102.18)	-162.35, -42.01	**0.001**	
Gender				
Women	Empty			
Men	-42.00	-106.16, 22.15	0.196	0.021
Neighbourhood Organisation Participation (yes=2, no=1)				
Pre neighbourhood organisation participation (2)	-51.25	-117.76, 15.26	0.129	0.029
Post neighbourhood organisation participation (2)	17.66	-61.70, 97.03	0.659	0.002
Membership				
Pre-membership (yes)	-62.16	-129.38, 5.06	0.069	0.041
Post membership (yes)	74.97	11.29, 138.65	**0.022**	0.065
Health Communication				
Change health communication	49.23	- -1.53, 99.99	0.057	0.045
Pre-health communication (yes)	-2.14	-66.86, 62.58	0.948	< 0.001
Post health communication (yes)	89.06	21.06, 157.06	**0.011**	0.079

Appendix O. Full table of deductive categories considered in the content analysis

Category	Questions	Category definitions	Coding Rules	*Anchored Examples*
PSYCHOSOCIAL	What migrant-related psychosocial factors are considered within the policy documents?	Explores migrant attitudes, knowledge of PA, health beliefs about PA, experience with PA, and PA preferences	Merged/crosscutting with other (likely sociocultural) contexts; as a subcategory e.g., these attitudes and experiences that impact integration aligned with the migration category under the subcategory "discrimination".	*"While most Australians (78 per cent) agree that accepting immigrants from many different countries makes Australia stronger, racial discrimination is still an issue…. In 2022, almost a quarter of people born overseas, and over a third of people who speak a language other than English reported experiencing discrimination.24"*
WORKPLACE	Is there consideration of workplace settings and workplace policies for engaging migrants?	Explore if/how workplaces support the engagement and integration of migrants using sport/PA.	Highlight successful examples of integrated economic and social participation	*The Panel views these services as a successful example of a more integrated approach to economic and social participation. They deliver outcomes for young refugees and other vulnerable migrants by improving workplace readiness, providing access to vocational opportunities, and creating strong social connections through education and sports engagement"*
POLITICAL	What similarities and differences exist across Local national and state political orientations?	Consider indicators of government influence, policy effectiveness through regulatory frameworks, resource allocation, and adaptive strategies within healthcare systems at local, national, and state levels.	Address this category through results, discussion, and recommendations at different governance levels.	***LOCAL:*** *In planning the strategic contexts for the provision of physical activity needs in the community consider - "Culturally and Linguistically Diverse groups view sport and recreation as family gathering opportunities rather than just for getting fit";* ***Local*** *arrivals in Australia;* ***STATE****: "Active Victoria – A strategic framework for Sport and Recreation Victoria 2017-21 • Aiming to support more people to tap into the benefits sport, and active recreation delivers."*

SOCIAL & CULTURAL	What social and cultural factors are identified and supported towards migrant integration and engagement in/via sport/PA?	Examine how social and cultural factors support migrant integration and participation in sport/PA, including the role of peer groups, social networks, supportive structures, and cultural requirements.	Look for barriers and facilitators that affect participation; use specific examples to illustrate findings.	*"Barriers also include the availability of culturally appropriate community programs. Considerations include the issue of mixed groupings in exercise classes, swimming pools, and the presence of male instructors/lifeguards as barriers to female migrant participation in particular"; example 2: "It is well known that when a community flourishes, its health tends to flourish too, enabling individuals to achieve their full potential. This is due to the close relationship between people's health and the circumstances in which people grow, live, work, play, and age – the wider determinants of health10 "……."It is these social, environmental, structural, economic, cultural, biomedical, commercial, and digital factors that lead to inequity and inequality within society. These circumstances, including the neighbourhood we grew up in"*
PHYSICAL ENVIRONMENT & OPPORTUNITY	What considerations are given to the availability of culturally sensitive facilities and improved accessibility for migrants?	Explore considerations for the availability of culturally sensitive facilities and improved accessibility for migrants, including sports facilities and neighbourhood amenities.	Note how facilities adapt to meet the needs of diverse communities; emphasize flexibility in design and use.	*"The hierarchy of facilities will respond to changing and emerging needs of the local community through flexible design where one, two or three different sports may operate from the same facility."*
SOCIAL & MATERIAL RESOURCES	Are there resources, like online platforms to enhance migrant access and social connection to	Explore Online social platforms for sport and PA		*"The Department launched an online interface in October 2019 to facilitate bringing the community together and is looking for other opportunities to link humanitarian entrants with the community".*

	migration of sport/PA?		
HEALTH & HEALTH COMMUNICATION	What does the policy state on healthcare and allied health provision on PA/sport recommend/message, and promoting migrant-friendly healthcare services?	Explore the role of healthcare providers in promoting PA and delivering migrant-friendly healthcare services. This includes how healthcare providers communicate about PA, integrate PA into healthcare practices for migrants, and address specific health needs of migrant populations.	*"There are also a number of other protective factors including access to interpreting services; respect for cultural differences and beliefs, including spirituality; shared decision-making; and the availability of accessible and quality health information"*
MIGRATION CONTEXTS	What does the policy say about migration-related aspects and barriers, particularly on discrimination and other equity aspects in migrant sports and PA participation?	Examine how the policy addresses migration-related aspects and barriers, including discrimination, equity, cultural adaptation, and integration challenges in sport/PA participation.	*"Finally, New Wealth, New Talent examined the growing economic and other influences of the Asia-Pacific region on Australian and global sport, and again, the last decade has seen this trend continue with growth in migration to Australia (predominately from the Asia-Pacific region and particularly from India, China, and New Zealand), and growing global sports participation in the South-East Asian region. 26,27"*
SPORT & PA	What do documents say about the representation and participation levels of migrants in sports?	Consider PA guidelines to facilitate their engagement, understand their preferred sports and activities, and tailor initiatives to support their participation & integration in/through sport	*"They suggested sport needs to do more to appeal to changing community demographics, such as understanding what sports would most appeal to new migrants and providing opportunities to engage with them. Opportunities to include these population groups must also be accompanied by supportive and empowering behavioural policies which*

				challenge many of the stereotypes of sport as male-dominated and Anglo-Australian."; example 2: "Although the benefits are great, the use of sport in acculturation to a new community is complex and should be done in consultation with specific cultural groups."
SECTOR & COLLABORATION	Who are the key partners mentioned in the document? (national, private sectors, nongovernment)	Key partners involved in developing and implementing sport/ PA policy docs (national, private sectors, nongovernment; authorities, municipalities, nongovernmental, media, associations, employers, etc)		*In Hume, the Brotherhood of St Laurence (BSL) uses a place-based approach to deliver YTS through an integrated, end-to-end delivery model. BSL works with organisations in the broader community to facilitate one-off events or ongoing programs"*
IMPLEMENTATION	Is there a clear plan and defined responsibilities for implementing the policy?	Assess the clarity of the implementation plan for the policy and the definition of responsibilities for those involved in executing it.		*"Youth Transition Support (YTS) is a holistic program designed to improve workplace readiness, provide access to vocational opportunities and create strong social connections through education and sports engagement"*
LEGAL COMPLIANCE	What legal mandates and compliance issues are addressed to support migrant PA and sport?	If the polices incorporate mandates/laws		*"...requires local councils to prepare a municipal public health and wellbeing plan within 12 months after each election of the council and have regard for the state public health and wellbeing plans in its preparation. These plans inform each other, providing the basis for an integrated planning approach in our state (Vic)"*
TARGET GROUPS	What specific characteristics of migrant populations	identified migrant population groups	For granularity where possible note specific migrant subgroups	*"Other target groups included middle-aged men, new migrants, and Indigenous Australians"*

	are prioritized in the policy?		frequently mentioned in policies (e.g., refugees, skilled migrants).	
GOALS AND TARGETS	What are the objectives and targets specified for migrant engagement in sport/PA?	Specified targets for migrants and time periods		*"Priority areas Inclusion Participation Promote environments that are safe and encourage participation and involvement across diverse cohorts, including…. migrants"*
TIMEFRAME	What is the timeframe for implementing the policy?	A clear timeframe specified for the implementation of the policy		*NONE*
BUDGET	What budget has been allocated to achieve the policy's objectives?	Specified budget (financial) allocated to implement the policy objectives		*"It (Victorian Government) did commit to $500k for the Tarneit Community and Performing Arts Centre business case to be developed and $5 million funding for an Indian Cultural Centre, with the location still to be determined".*
EVALUATION	What frameworks guide the planning and evaluation outcomes for migrant participation in sport and PA?	Assess the budget allocated for achieving the policy's objectives, including specified financial resources.		*"The existing National Settlement Framework already provides a high-level structural blueprint for Commonwealth, state, territories and local government to work together to effectively plan and deliver services that support the settlement of migrants and new arrivals in Australia (including refugees and asylum seekers). It provides a guide to how best to make planning decisions on the provision of settlement and support services. It promotes the delivery of coordinated services, informed by research and evaluation."*

Appendix P. SRQR reporting checklist for qualitative focused policy study described within Chapter 8

		Reporting Item	Within chapter section/subsection
Title			
	1.	Concise description of the nature and topic of the study identifying the study as qualitative or indicating the approach (e.g. ethnography, grounded theory) or data collection methods (e.g. interview, focus group) is recommended.	Chapter Title
Abstract			
	2	Summary of the key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results and conclusions.	NA in a thesis chapter, included in publication
Introduction			
Problem formulation	3	Description and significance of the problem / phenomenon studied: review of relevant theory and empirical work; problem statement.	Introduction: para 1 and 2
Purpose or research question	4	Purpose of the study and specific objectives or questions	Introduction: para 4 and 5
Methods			
Qualitative approach and research paradigm	5	Qualitative approach (e.g. ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g. postpositivist, constructivist / interpretivist) is also recommended; rationale. The rationale should briefly discuss the justification for choosing that theory, approach, method or technique rather than other options available; the assumptions and limitations implicit in those choices and how those choices influence study conclusions and transferability. As appropriate the rationale for several items might be discussed together.	Methods: Para 1, and accompanying definitions
Researcher characteristics and reflexivity	6	Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience,	Methods: Reflexivity statement - Para 1; Chapter prelude

		relationship with participants, assumptions and / or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results and/or transferability.	
Context	7	Setting/site and salient contextual factors; rationale.	Methods: Design and Settings – para 1; Contextual domains – para 1.
Sampling strategy	8	How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g. sampling saturation); rationale.	Methods: Information sources and search strategy – para 1 and 2. Methods: Design and setting included saturation. Methods: Eligibility criteria and screening- inclusion and exclusion criteria.
Ethical issues pertaining to human subjects	9	Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues.	Methods: Design and setting – include a statement on ethics.
Data collection methods	10	Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale.	Methods: para 1 and 2. Methods: Information sources and search strategy – para 1 and 2
Data collection instruments and technologies	11	Description of instruments (e.g. interview guides, questionnaires) and devices (e.g. audio recorders) used for data collection; if / how the instruments(s) changed over the course of the study.	Methods: Development of the category system (coding framework); Unit of analysis and coding rules – para 1 and 2; Table 15; Appendix O.
Units of study	12	Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results).	Results - Document selection para 1; Figure 12; Table 16
Data processing	13	Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymisation / deidentification of excerpts.	Methods: Analysis procedures – para 1

Data analysis	14	Process by which inferences, themes, etc. were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale.	Methods: Analysis procedures – para 1 and 2
Techniques to enhance trustworthiness	15	Techniques to enhance trustworthiness and credibility of data analysis (e.g. member checking, audit trail, triangulation); rationale.	Methods: Analysis procedures – para 1 and 2; Appendix P.
Results/findings			
Syntheses and interpretation	16	Main findings (e.g. interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory.	Results: B. Content analysis – para 1; Table 18. Table 17; Appendix Q; Appendix R
Links to empirical data	17	Evidence (e.g. quotes, field notes, text excerpts, photographs) to substantiate analytic findings.	Results: Content analysis - para 1 -15
Discussion			
Integration with prior work, implications, transferability and contribution(s) to the field	18	Summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contributions(s) to scholarship in a discipline or field.	Discussion: para 1-10. Discussion: Recommendations – para 1-3. Conclusion
Limitations	19	Trustworthiness and limitations of findings.	Discussion: Strengths and Limitations – Para 1 and 2
Other			
Conflicts of interest	20	Potential sources of influence of perceived influence on study conduct and conclusions; how these were managed.	NA
Funding	21	Sources of funding and other support; role of funders in data collection, interpretation and reporting.	NA

Note. The authors acknowledge using the SRQR checklist when writing our report O'Brien et al. (2014). SPQR Reporting guidelines: O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. Acad Med. 2014;89(9):1245-1251.

Appendix Q. Illustration of the prevalence, frequency, and coding references of the coded documents across government levels

Table A: *Distribution of number of documents coded across predefined categories by government levels (federal, state, and LG Areas) highlighting absolute counts and percentages (n%).*

Categories	Federal	State	LGA	Total Files
Migration*	4 (50.0)	1 (12.5)	3 (37.5)	8 (100)
Target groups	6 (100)	0 (0.0)	0 (0.0)	6
Political	4 (80.0)	0 (0.0)	1 (20.0)	5
Social and Material Resources	3 (75.0)	0	1 (25.0)	4
Physical Environment Opportunity	1 (25.0)	1 (25.0)	2 (50.0)	4
Goals	3 (75.0)	0 (0.0)	1 (25.0)	4
Social and Cultural	2 (66.67)	0 (0.0)	1 (33.33)	3
Implementation	2 (66.67)	0 (0.0)	1 (33.33)	3
Health Health-communication	2 (100)	0 (0.0)	0 (0.0)	2
Sectors & Collaboration`	2 (100)	0 (0.0)	0 (0.0)	2
Occupation	1 (100)	0 (0.0)	0 (0.0)	1
Budget	0 (0.0)	0 (0.0)	1 (100)	1
Evaluation	1 (100)	0 (0.0)	0 (0.0)	1
Psychosocial	0 (0.0)	0 (0.0)	0 (0.0)	0
Legal	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Timeframe	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
TOTALS	9 (60.0)	1 (6.67)	5 (33.33)	15

Note: Shaded distribution and intensity interpretation:

Dark shade indicates high intensity or frequency i.e., more documents coded to a category. Light colour indicates lower frequency **i.e.,** few documents coded to category.
*Codes related to social and cultural contexts e.g., demographic shifts

Table B: Distribution of coding references (codes) by categories across government levels (*n*%)

Categories	Federal	State	LGA	Total Coding References
Migration*	17 (53.12)	2 (6.25)	13 (40.62)	32 (100)
Social and Material Resources	12 (85.71)	0 (0.00)	2 (14.29)	14
Physical Environment Opportunity	5 (38.46)	2 (15.38)	6 (46.15)	13
Target Groups	12 (100)	0 (0.0)	0 (0.0)	12
Social and Cultural	10 (90.91)	0 (0.00)	1 (9.09)	11
Goals	9 (81.82)	0 (0.0)	2 (18.18)	11
Political	10 (90.91)	0 (0.0)	1 (9.09)	11
Health and Health-Communication	7 (100)	0 (0.0)	0 (0.0)	7
Implementation	3 (75.0)	0 (0.0)	1 (25.0)	4
Occupation	3 (100)	0 (0.0)	0 (0.0)	3
Sectors & Collaboration	3 (100)	0 (0.0)	0 (0.0)	3
Budget	0 (0.0)	0 (0.0)	0 (0.0)	0
Evaluation	2 (100)	0 (0.0)	0 (0.0)	2
Psychosocial	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Legal	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Timeframe	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
TOTALS	93 (74.4)	4 (3.2)	28 (22.4)	123 (100)

Note: Shaded distribution and intensity interpretation:
Dark shade indicates more coded references to a category.
Light colour indicates few coded references to the category.
*Codes related to social and cultural contexts with migration.

Appendix R. Coding references for nominal categories with all main categories of the deductive coding system framework across government levels

Nominal Category	Main Category	Federal (*n* %)	State (*n* %)	Local (*n* %)	**Totals (*n*=15)**
Policy Implementation	Target Groups	12 (100)	0 (0.0)	0 (0.0)	12
	Implementation	4 (80.0)	0 (0.0)	1 (20.0)	5
	Goals/Priorities	14 (87.5)	0 (0.0)	2 (12.5)	16
	Budget	0 (0.0)	0 (0.0)	2 (100) ^	2
	Sector & Collaboration	3 (100)	0 (0.0)	0 (0.0)	3
Inclusivity and Equity in Sport	Migration Contexts	15 (48.4)	2 (6.5)	14 (45.1)	31
	Social & Cultural	9 (90.0)	0 (0.0)	1 (10.0)	10
	Social & material resources	12 (85.7)	0 (0.0)	2 (14.3)	14
	Occupation	3 (100)	0 (0.0)	0 (0.0)	3
	Physical Environment & Opportunity	0 (0.0)	2 (20.0)	8 (80.0)	10
	Health & Health Communication	7 (100)	0 (0.0)	0 (0.0)	7
	Psychosocial	0 (0.0)	0 (0.0)	0 (0.0)	0
Evaluation and Outcome Indicators	Evaluation	2 (100)	0 (0.0)	0 (0.0)	2
	Legal Compliance	0 (0.0)	0 (0.0)	0 (0.0)	0
	Timeframe	0 (0.0)	0 (0.0)	0 (0.0)	0
	Total Counts (Number of Documents)	9 (60.00)	1 (6.67)	5 (33.33)	16 (100)
	Total Coding References	91 (74.0)	4 (3.2)	29 (23.4)	124 (100)

Appendix S. Summary of findings after completion of the systematic review

a. Studies assessing physical activity and sedentary behaviour of Indians in country-of-origin

Study	Obj.	Participants	Measures/analysis	Findings	Comments
Yadav et al, (2025) Rural Punjab, North India	to estimate the prevalence and determinants of PA and SB among rural adults in Punjab, North India.	rural adults aged 18–75 convenience sampling	Cross-sectional study *Demographic*: age, sex, literacy status, marital status, current employment status, family size, annual income *Lifestyle*: Smoking, diet, alcohol via pretested and modified interview schedules through face-to-face interviews self-reported PA/SB – GPAQ Adj. binary log reg.	PA prevalence: 13.3% SB prevalence: 10.4% transportation-related PA: 86.91% participant engagement low PA associated older age [OR 1.75 (1.118–2.74), *p* value 0.014], unemployment status [OR 1.61 (1.08–2.67), *p* value 0.02], retired/dependent status [OR 2.30 (1.34–3.94), *p* value 0.002 High SB associated older age [OR 3.53 (1.94–6.42), *p* value < 0.001], unmarried/widowed/separated status [OR 1.73 (1.16–2.59), *p* value 0.004], retired/dependent status [OR 2.63 (1.49–4.63), *p* value < 0.001]	Need to emphasize the importance of recreational PA to reduce sedentary time and promote overall wellbeing.
Verma et al (2025)	To explore PA patterns in	N=3918	MPAQ	PA: 31.7% MEN; 20% W SB: 73.6%	

Haryana	Haryana through a subgroup analysis of national (ICMR-INDIAB) study	Dec 2018 and July 2019	Student's unpaired t tests, one-way ANOVA, or chi-square. Multivariable nominal regression analysis SPSS	Mod-Vig: 26.4% <u>max time spent</u> General PA/ADLS (napping, sleeping, personal chores): 738.4 +- 177.9 min, LTPA: 454.4 +_ 189.2 OPA: 435.7 +_ 124.9, Transport: 79.5Å+_49.0 Low PAL age (60+), women, urban, low SES, obesity individual.	
Vatta, Pandey et al (2025) Varanasi	To explore the usage of open gyms (OG) and the perceptions of the users about OG in a public university setting	Quant: Observation Spring/winter Qual: Face-to-face, semi-structured in-depth interviews (N = 66) purposive sample (OG) users conducted in Hindi.	Sequential explanatory mixed-methods study design Descriptive statistics; thematic analysis;	Quant phase 1: Descriptive observation men more OG vs women, increased freq. in spring vs winter and weekend vs weekdays. Qual phase 2: Key themes (i) Perceived benefits using Ogs (physical-mental benefits, proximity to nature, opportunity to socialize, safe environment, economical, ease of access for everyone);	built environment interventions using OGS may be useful in India to improve uptake.

				(ii) Perceived challenges using OGs (lack of time, overcrowding, damaged equipment, laziness); (iii) Feedback for improvement OGs (regular maintenance of gym equipment, installation of more equipment, installation of drinking water stations and restrooms).	
Oswal, Kanodia et. al., (2021) North-east (NER) India	to determine the assn. b/n lifestyle practices that are potential risk factors for dev cancer.	N=1400 Cross sectional Assam, Nagaland & Meghalaya Ages: 25–64 years	Questionnaire VAR (socio-demographic): age, income, education, gender & DV: tobacco, alcohol consumption, PA leisure. Multivariate PA; Log regression assc. Lifestyle practice & IV STATA	PA: 62 % rarely or never engaged any LTPA; Men greater involvement 36% vs Women 27%. PA Type Preferred: Women: Yoga (36%) Men: Form of active Sport (88%) Strong r/n with gender, age and household income & LTPA (east India)	
Suraj & Singh (2011)	To explore level of engagement of north Indian students in health promoting	Chandigarh college students M= 100 F= 100 Ages:	HPLP-II (walker et al) Sense of Coherence (SOC)	<u>Health responsibility</u> Females: consulted doctors more frequently than males ($p<0.05$). more sense of H responsibility vs. males	lifestyle of educated youth in north India has reasonably

behaviours; (*ii*) to determine their sense of coherence scores; (*iii*) to ascertain the determinants of health promoting behaviours of these students.	Orientation to Life Questionnaire (OLQ-29 version) SPSS T test X^2 test Pearson product correlation Stepwise linear regression	<u>PA</u> Male: more muscle stretching exercise (55 vs 34%; p<0.05); played outdoors game (59 vs 21% *p*<0.05); Sig. More involved in PA. Female: more yoga (18 vs 9%; p<0.05) <u>Stress management</u> No sig. gender diff. stress control methods Common methods: watching TV, movies, shopping, regular sleep (reported by 65%); speaking with friends (reported by 59%), relaxation techniques (21%) <u>interpersonal relation</u> females: more faith in God (92 vs 77%; p<0.05); what was important in life (89 vs 79%; p<0.05); “Listen to your friends’ problems” (91 vs 78%; *P*<0.05);	good orientation towards health promotion. Indian Cultural ethos where females more involved in the value of religion/faith in God, valued by Indians

				"Maintain & meaningful relationships with friends" (88 vs 77%; *P*<0.05), "Do find way to meet your friends" (75 vs 61%; *P*<0.05) <u>Overall HPLP</u> No sig gender-wise difference <u>Correlations</u> Sig correlation age with HPLP scores - male & female (r=0.328, p<0.001,) positive correlation b/n HPLP & SOC scores of students.
Garg & Kutty (2019) Kerala	To examine the perceptions of adults in Kerala of the importance of health promoting PA and identify various facilitators, motivators and barriers to PA	Men & women ages: 18-65 yrs. N=28 Maximum variation sampling	In-depth interviews (fitness instructors, frontline workers) FGRs, (men, women, low SES, patients) Inductive & deductive coding. Axial coding; constant comparison	Preferred PA modes: Walking, running Men: sports-swimming, cycling, football, badminton vs. trekking/hiking or other vig. PA Women: yoga, Zumba vs. gym, treadmill Conceptualization: Exercise western concept; habitual PA is sufficient. Motivators:

Men activities with children, women group activities, social media messages, holistic health benefits, accessible affordable facilities.

Barriers:
Low awareness on screen-time, laziness (attitude), perceived housework sufficient PA, safety, facility cost barriers (women)

Sociocultural gender norms
Women traditional activities: transition collecting water & firewood, walking for fodder (non-mechanised) to mechanized (sedentary).
- Family first.
Class: Leisure PA upper class privilege. Lower class work harder, middle class cost barriers nor involved in affordable labor.

					Health communication: doctor advice on lifestyle (walking) but limited in time and intensity. schools - focus on weight loss. TV- focus on disease. Participants Suggestion: friendlier and acceptable manner, to include role models and communicate in everyday comprehensible.

b. Summary assessing physical activity and sedentary behaviour of Indian migrants globally (including Australia)

Study	Obj.	Participants	Measures/analysis	Findings	Comments
O'Callaghan et al. (2021) Sydney, Australia	To investigate the prevalence and predictors of multimorbidity	N= 203 first generation immigrant Indian women Age: 66.11 (±9.59) years, 33% in the 50-60 ; 61-70 years age groups, 34% in the 70 + years age group.	Cross-sectional descriptive -part of a larger study "Measuring Acculturation and Psychological Health of Senior Indian Women'	Prevalence multimorbidity = 73.9% CVD = 67. %; Diabetes = 31.5%; Osteoarthritic= 57.6%, Depression = 37.4%. Results could be due to lack of PA in new country + CHO consumption low prevalence of multimorbidity PA individuals.	Women majority India, also included Kenya, South Africa, Fiji, East Africa, Malaysia, Pakistan, Sri Lanka suggests that health interventions should target first generation migrants,

		37.4% were physically active Most spoke English & Hindi; less than half spoke Gujrati		acculturative stress linked to increased settlement time on obesity ethnic identity - predictor for multimorbidity	promote retention of their original healthy behaviours.[37]
Pullia, Jeemi et al, (2022) Western Australia	1. Explore SA Women beliefs, attitudes, knowledge of PA 2. Understand SA PA experiences and PA types 3. Understand barriers and facilitators	SA Women: India, SL, Pakis, Bhutan, Nepal Migration yrs: 4 - 32 Age: 33-63 yrs, median 48y	FGR thematic content analysis	Theme: Experiences of migration before and after *Current PA:* Walking (5-50min), Yoga (45-60min), meditation (PA type) PAL change with migration: “more active in their home countries since they either did not have access to a personal vehicle or had limited access to public transportation for travel” Age factor. Preferred PA type: Yoga, Meditation preferred	

				Barriers: time, cost, lifestyle stress family commitments, low social networks, *Facilitators*: low cost, free childcare facilities, late evening group classes (complete housework), women only facilities advantageous, local access to gym	
Thanawala et al (2020) US	To examine the assoc. btn social networks, PA, & atherosclerosis mediators	SA immigrants MASALA cohort Avg. age 59 y 44% females	Ego network: interview (about alters) - Important matters >10 alters Ego-alter first 5 alters. Socio-demo (Birth country, Age) Rship type; Strength rshp (Emotional	*Association btn Social Networks & PA:* Positive correlation strong social networks higher PAL *Association between Social Networks and Atherosclerosis*: Inverse relationship, indicating a potential protective effect *Association between PA and Atherosclerosis:* Lower levels of atherosclerosis mediators observed in individuals with higher levels of PA	Strengths Adequate sample size, comprehensive assessment of social networks, PA, and atherosclerosis mediators **Conclusion: Strong social networks may contribute to reduced atherosclerosis risk in SA in America through increased PA.

			Closeness, Freq. of contact); Alters exercise behaviours. Network density, size, alters characteristics and exercise behaviours. questionnaire assessing social connections & support. IPAQ SNA Measures not validated on SA/multiethnic.	*Mediators of the Association*: Social support, self-efficacy in PA, and psychological well-being were identified as potential mediators in the relationship between social networks, PA, and atherosclerosis	Interventions targeting social support and self-efficacy in PA could be beneficial for cardiovascular health in this population
Rahman, Johnson et al (2025) US	To broaden the understanding of young South Asian women's experiences and	five South Asian women aged 18–25	Phenomenological design, semi structured interviews	Themes: representing cultural negligence or awareness within American society;	To promote the better involvement of SA in PA, it is necessary to discuss the societal factors

	relationship with participation in LTPA at US-universities	India, Pakistan, and Bangladesh			and cultural considerations that may be different within and across cultures.
Kandula et al (2025) US	Evaluate effectiveness of dyadic, culturally adapted behavioral intervention to increase MVPA US SA mothers + adolescent daughters.	SA women and girls N= 126 South Asian mother-daughter (11-16y) dyads SAATH RCT	18-week behavioral intervention: exercises classes, discussion groups, and activity tracking tools Primary: between-group difference accelerometer-measured MVPA change from baseline to 4 months using intent-to-treat analyses. Secondary outcomes: light PA, step count,	Mean (SD) age: Mothers 42.8 y; 13.5 (1.7) y daughters. mothers, 94% born outside US. Mean difference MVPA change in the intervention vs control group were -2.4 m/d (95% CI, –7.2 to 2.4 m/d) for mothers and –2.5 minutes/day for MVPA (95% CI, -11.6 to 6.5) for daughters. Intervention participation not assoc. wi improvements in sec. outcome.	A dyadic, culturally adapted PA intervention was not more effective than written health education materials for improving MVPA among SA mothers and adolescent daughters. Effective PA promotion across the lifecourse for this elevated-risk population requires further investigation.

			sedentary time, self-efficacy, and mother-daughter communication.		
Daniel et al, (2024) US	To determine the feasibility of implementing the program with attention to (1) recruitment, (2) engagement (attendance), (3) satisfaction with the program (acceptability), and (4) ability to obtain measures (outcome and intervention targets) at baseline and 12 weeks (retention).	12-week design: N = 6 Intervention: a) Fitbit; women daily b) 55 min, 1x Week zoom Bollywood dance women led by bilingual nurse, [gradually increased their frequency, duration, and intensity as tolerated for	Bandura's social cognitive theory (Bandura, 2004) and Pender's health promotion model (Pender et al., 2015) for component c. Moderator and mediator of dance and dyad to overcome barriers to partake in PA lifestyle. outcomes measures: (a) lifestyle PA (steps/day, min of MVPA per week	From baseline to 12 weeks: 50% improv av steps/d (1367.43 [SD = 1425.1]) and MVPA min/w (5.63 [SD = 7.5]) ActiGraph, no sig difference. No changes blood pressure (range SBP 113-145; DBP 62-88), BMI (range 19.8-33.7), or waist circumference (range 31 to 38.5). significant improvements in the aerobic fitness measure of two-minute step test and self-efficacy for PA (p = < .05).	Adding 3,000 steps per day moves an individual from the "low-active" (5,000-7499 steps per day) into the "somewhat-active" (7500-9999 steps per day) category (Buchholz et al., 2020) Component b: 10-min warm-up, 40-min moderate-intensity dance, 10-min cool-down, and a five-minute post-dance reflection dance

	each subsequent session]	ActiGraph and self-report,	
c)	60min Fortnightly zoom dyads group meeting	(b) cardiovascular aerobic fitness, blood pressure, body mass index [BMI], waist circumference.	all the women worked in desk jobs requiring prolonged sitting. Limitation: no control group Intervention need more testing
Inclusion: Women= 40-65 y (2) born-India + imm U.S. for < 12 years, (3) first-gen spouse or partner, (4) < 7,500 av step/d (5) dyads conversant in Hindi, (6) computer or mobile device		Vancouver Index of Acculturation with SAI heritage (10 items) and mainstream American (10 items) culture-orientation subscales (Ryder et al., 2000). Experiences of Discrimination (EOD) scale for situations (9 items), frequency (4	

		internet access Exclusion: (1) health or physical diability prevent participation PA	items), and response to unfair treatment (3 items) (Krieger et al., 2005)		
Duca and Parry 2024 Malta	Explored the impact of football on the dynamics, cultural integration, and social interactions within the Indian community in Malta, focusing on their migration experiences.	N=5 Indian men (Kerala) Malta residents. purposeful sampling	Structured phenomenological interview Thematic analysis (Braun and Clarke 2006)	Indispensability: break life's monotony, offering avenues for social interaction and personal fulfilment. Transcendence: clarity and freedom On field experience, football provides a sense of liberation from the constraints of daily life, happiness, escape Social Bonding (strong theme): formation of meaningful friendships (fosters social bonding. Shared experiences, common goals, and interpersonal connections) through their shared passion for the game; creation of a tightly knit community,	football - catalyst for community cohesion, fostering identity, unity, and belonging. It serves as a platform for social inclusion, bridging cultural gaps and facilitating interactions with other communities limited: Skipping questions for comfort disrupted the interview flow. Logistical issues, including the

	transcends cultural boundaries locally in Malta and even across Europe. Transformation: strangers to friends extended to wider supportive community. Identity and Growth: facilitate development of a collective identity, proudly represented their chosen club and the Indian community. sense of identity + belonging contributed significantly to personal growth + resilience, allowing them to overcome challenges on field. Holistic health: Sport engagement positively impact on physical, mental, and emotional well-being, with the holistic nature of sport well-being	inability to interview a participant who returned to India and unreliable internet connections, limited cross-cultural insights, consequently negating comprehensive exploration. Conducting interviews at homes led to disruptions, affecting quality Authors suggest a pilot project encourages mixed-nationality teams to promote inclusivity and diversity within the expatriate

	community, aligning with its goal of unity through football.

C. Review Studies

Study	Loc.	Objectives	Participants	Methods	Results
Fischbacher, Hunt & Alexander (2004)	U.K.	Assessed the evidence that PA is lower in SA groups than in the general population.	SA (Indian, Pakistani and Bangladeshi)	Systematic literature review Adult = 12 studies children = 5 studies	Low levels of PA among UK SA ethnic groups.
Caperchione et al., (2009)	Global	Outlined the barriers, challenges and enablers of PA.	Culturally and linguistically diverse migrants (CALD) in Western society.	Review	Physical inactivity key contributing risk factor to chronic disease in migrant CALD groups. Barriers include: cultural and religious beliefs, issues with social relationships, socioeconomic challenges, environmental barriers, and perceptions of health and injury. Need for cultural sensitivity and the provision of education sessions addressing health behaviours.
Bauman et al., (2009)	Global	comparative international study of population physical activity prevalence across 20 countries.	IPAQ to assess PA participation 20 countries [total N = 52,746, aged 18–65 years].	Face to face IPAQ interviews; self-administered n=6 countries questionnaires n=8 c Measured household, leisure work, transport	High volume vig-intense PA = New Zealand, Czech Republic, USA, Canada and Australia. more PA males= most countries more PA females= argentina, Portugal, Saudi PA influenced by local infrastructure + culture

				Demerits of IPAQ: understanding survey by Culture/response Variations across countries response rates	
Daniel & Wilbur (2011)	Unknown	Correlates of lifestyle (leisure-time, household, and occupational) PA behaviour of healthy SAI immigrants.	South Asian Immigrants (Indian)	Integrative review methodology: Cross-sectional studies N=11 Qualitative studies N = 4	Correlates of PA: Socio-cultural variables, current health, acculturation; female sex; poorer health; and less time since immigration. Few studies focused on social support, environmental factors, motivational factors. More knowledge on factors that impact PA lifestyle needed.
Babakus & Thompson (2012)	Global	Assessed levels of PA and sedentary behaviours	SA immigrant women	Systematic mixed methods review Qualitative studies N = 12 Quantitative studies N=26	SA women showed low levels of PA compared with SA men. Cultural and structural barriers to PA, faith and education as facilitators, with lack of understanding of the recommended amounts and PA benefits among SA women. More research needed to standardise objective PA measurement and how to utilise resources of individuals and communities to increase PA levels.

Patel et al., (2012)	Global	Cultural barriers to behaviour change to modifying diet and exercise behaviours.	SA men & women Total =91 studies 25 cited articles on migrant SA cultural influences on behaviour change.	Review article	Themes identified Gender roles, body image, physical activity misconceptions, cultural priorities, cultural identity.
Bhatnagar et al., (2015)	UK	To report variation in PA behaviour prevalence in quantitative studies & variations in attitudes, motivations and barriers to PA in qualitative papers.	SA Indian, Pakistani, Bangladeshi (Male and female).	Systematic review Total = 46 Quantitative N= 29 Qualitative N= 17	Motivators, barriers to adult second-generation SA in the UK. Clear variation in PA levels among UK South Asians. Second-generation SA more PA than first-generation. No high quality qualitative studies on second-generation SA.
O'Driscoll et al (2014)		To Identify Studies that Examined the Correlates of Sport and PA Participation in Migrants	CALD migrant	Systematic review N= 72 papers, n= 6 interventions, n= 18 qualitative (10 FGRs, 6 interviews, 2 case studies) n=48 quantitative, n= 30 surveys/questionnaires,	44 identified correlates - four themes: *Demographic:* Being unmarried [53, 54] or living alone [55] was associated with higher levels of physical activity for women. *Psychosocial and environmental/organisational* unique CALD migrant groups and include:

				14 descriptive, 2 self-reported, n= 2 accelerometers. Social ecological model	*acculturation:* greater acculturation assc increased participation in sports & PA and in some studies, PA & sport seen as a means of acculturation. Higher participation rates – a longer time in the country (10 years+) [39, 40], later generations (being born and having parents born in the new country) [41] and citizenship in the new country [42]. Citizenship and command of the English language.
Horne et al (2018)	Global	To locate studies of interventions aimed at SA adults to increase PA, and to identify specific changes to their content and delivery mode for this population.	SA adults' populations community-dwellers aged 18 y;	Systematic Review - Quant studies; Narrative synthesis outcome: reporting determinants of PA, exercise, or a combination of the two, measured objectively or using self-report, articles in English	16 articles, reporting 15 trials/programmes *Healthy lifestyle:* PA part of a group-based intervention using aerobic exercise, built on SA folk dance; culturally tailored dance Programmes, or standard gym-based exercise. *Design theory of content:* Social cognitive theory; theory of planned behaviour; trans theoretical model and self-efficacy

				31 January 2017.	involving the target community in developing culturally appropriate interventions appears important in their acceptability, delivery and uptake; suggest that cultural adaptations of interventions make them more accepted in target population, but more evidence needed.
Sarkar, Bhowmick, Yumkaibam (2024)	India	To systematically evaluate PA patterns Indian states, identifying variations by age, gender, socioeconomic status, and geographical regions while assessing their public health implications	Indian states various	Systematic Review N=33 studies Inclusion: Indian-focused; reported demographics; defined PA Exclusion: Outside India, non-english, overlapping data, unclear methodologies	Sig. regional differences <u>Key Determinants:</u> *Age*: younger more inactivity *Gender*: females more inactive *Urban* more inactivity vs rural *Geographical variations:* Kerala, inactivity notably high (65.8%), vs Chandigarh reported slightly lower rates Findings suggest urgent policy action

Updated Summary of correlates of physical activity from cross-sectional studies on Indian migrants

Study	Country	Design	Sample	Findings
Jonnalagadda & Diwan (2005)	U.S.	Cross-sectional	Indian migrants in U.S (average residence 25 years) n= 226; 162 men and 64 women Ages: 50 + years	Younger age, longer length of residence and a bicultural or more American ethnic identity were associated with greater PA
Kolt at al., (2007)	New Zealand	Cross-sectional	South Asian in New Zealand (average residence 51 months) n= 112 Men n= 50 Women n= 62 Ages: 44-91 yrs.	Length of residence associated with PA.
Sinnapah et al., (2009)	Guadeloupe	Cross sectional	Indian migrants in Guadeloupe (length of residence unknown) n=60 Ages: 17 to 66 years	Ethnicity = ↓ EE Ethnicity = low PA
Daniel et al., (2013)	U.S.	Cross-sectional	Indian migrants n=110; Age mean 53 y	LTPA significant with education
Joseph, Hanneman & Bishop (2019)	U.S.	Cross sectional	Indian women, n = 262 Aged 21–60 Immigrant & non-immigrant groups	Low acculturation women (high Asian identity) highest levels OPA, HPA, total PA. High acculturation (American identity) women LTPA and more sedentary behavior. Acculturation, more than immigrant status, influenced PA type.
Thanawala et al. (2020)	U.S.	Cross sectional	South Asian immigrants Avg. age: 59 years	social networks are associated with PA. Number of exercising partners, number of exercising alters associated with higher MVPA levels.

Updated Summary of correlates of physical activity from cross-sectional studies on Indian migrants

Correlate	Study	Location	Statistical analysis	- (less PA)	0 (no association)	+ (more PA)
Age	Jonnalagadda & Diwan (2005)	U.S.	Multiple regression coefficient	Increased age p <0.0014	-	-
Greater length of residence	Jonnalagadda & Diwan (2005)	U.S.	Multiple regression coefficient	-	-	r= 0.09
	Kolt et al., (2007)	New-Zealand	Pearson' s correlation Partial r (age, sex)	r = -0.23 p= 0.02 r= -0.19 p= 0.05	-	-
Ethnic identity	Jonnalagadda & Diwan., (2005)	U.S.	Multiple regression coefficient			Bicultural & more American r= 0.39
Ethnicity	Sinnapah et al., (2009)	Guadeloupe	Two-way ANOVA	P= 0.003		
Education	Daniel et al. (2013)	U.S.	Stepwise regression	Less education p = 0.042		
Acculturation	Daniel et al. (2013)	U.S.	Bivariate Pearson's Correlation			Higher American more MVPA
	Joseph, Hanneman & Bishop (2019)	U.S.	Kruskal-Wallis H test	$p < .001$		HPA, OPA, Total LTPA Low acculturation immigrants
Social Networks	Thanawala et al (2020)	U.S.	ANOVA	p<0.01		Men with non-spouse exercise partners; Women with spouse exercise partners