

TEACHERS' WORKPLACE:  
PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR

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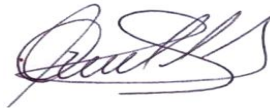
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## Attestation of authorship

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 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.



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Marcelo Castillo

4<sup>th</sup> December 2013



## Research outputs

### Peer review publication

1. Castillo M, Hinckson E. Measurement of physical activity and sedentary behaviour at work: A review. *WORK: A Journal of Prevention, Assessment, & Rehabilitation*. Vol. 4, Issue 40, December 2011. (Accepted on 26 March 2011).

### Conference and seminar presentations

1. Castillo M. Measurement of physical activity and sedentary behaviour at the workplace: A critical review. In: 2009 University Postgraduate Symposium - *'New Directions, Challenges and Applications'*; AUT University, Auckland, New Zealand: 2009. p. 13.
2. Castillo M, Hinckson E. Measurement of physical activity and sedentary behaviour at the workplace. 11<sup>th</sup> Annual New Zealand Work Research Conference for Research Students. Massey University, Rotorua 22 May 2010. New Zealand.
3. Castillo M. Primary school teachers' physical activity and sedentary behaviour profile. 2011 University Postgraduate Symposium; AUT University, Auckland, New Zealand: September 2011. p. 18.

4. Castillo M. IX<sup>th</sup> International Research and Development Conference in Physical Activity Sciences and Health. University of Tarapaca, Arica, Chile. Presentation: Physical activity and sedentary behaviour at the workplace. 13 – 16 July 2012.
5. Castillo M. I<sup>st</sup> International research meeting of Physical Activity Sciences, Education and Health. Catholic University of Temuco, Temuco, Chile. Presentation: Physical activity level, sedentary behaviour profile and cardiovascular risk of primary school teachers. 19 – 21 July 2012.
6. Castillo M. Sport, Health and Quality of Life Seminar. Universidad Autónoma de Chile, Talca, Chile. Guest Speaker. 6 June 2012. Two presentations: 1) Health and sport perspective in the physical education teachers' training and 2) Health and quality of life concepts associated with physical activity in the Third Millennium society.
7. Castillo M. The 2<sup>nd</sup> Latin American and Caribbean Conference on Global Health. University of Chile, Santiago, Chile. Presentation: Is teaching a sedentary occupation? 9 – 11 January 2013.

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## Abbreviations

BMI	:	Body Mass Index
CVD	:	Cardiovascular Disease
CVR	:	Cardiovascular Risk
DLW	:	Doubly Labelled Water
EE	:	Energy Expenditure
HDL	:	High – Density Lipoprotein
HPQ	:	Health and Work Performance Questionnaire
IPAQ	:	International Physical Activity Questionnaire
LDL	:	Low – Density Lipoprotein
MET	:	Metabolic Equivalent Unit
MVPA	:	Moderate – to – Vigorous Physical Activity
NCD	:	Non-communicable disease
NEAT	:	Non-Exercise Activity Thermogenesis
OD	:	Odd Ratio
OPA	:	Occupational Physical Activity
PE	:	Physical Education
QHPA	:	Habitual Physical Activity Questionnaire
RSI	:	Repetitive Strain Injury
SD	:	Standard Deviation
VLDL	:	Very Low – Density Lipoprotein
WHR	:	Waist-Hip Ratio

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## Abstract

The high rate of global mortality due to non-communicable diseases has encouraged researchers to identify the major factors that are associated with increased prevalence of cardiovascular disease, diabetes and other preventable disorders. Lower levels of occupational physical activity, as well as other factors associated with modern life have increased habitual sedentary behaviour, despite the efforts made by governmental and non-governmental organisations to reverse this trend.

The working population spend nearly a half of their waking hours in the workplace making occupational settings an ideal environment to study physical activity and sedentary behaviours. While many occupations have been researched, primary school teachers' workplace physical activity has not been examined. Teachers are a large occupational group with the capacity to influence children, parents and the wider community's, medium- and long-term physical activity behaviours. The principle questions of this thesis included; Are teachers sufficiently active in their daily life? Do the teaching profession and the work environment allow teachers to be physically active? Does the work environment affect teacher's health? Do workplace conditions affect their work productivity? Does teachers' sedentary behaviour or physical activity influence their student's physical activity? Therefore, the aims of this thesis were: 1) to identify aspects that facilitate or impede New Zealand primary school teachers' involvement in physical activity; 2) to quantify physical activity and sedentary behaviour in teachers, and determine their cardiovascular health status; and 3) to determine the relationship between physical activity and sedentary behaviour of teachers and their students.



A mixed methods approach (qualitative and quantitative) was employed throughout this thesis, utilising a convenient sample of 103 primary school teachers and 131 of their students from 21 schools located in a variety of socioeconomic neighbourhoods in Auckland, New Zealand. Data were collected over two weeks at each school during February-November in 2011.

A qualitative approach was used to determine teachers' perception about their workload and the barriers that exist to being physically active at school. Voice recordings of semi-structured interviews (n= 8) conducted with teachers and principals from the participating schools were transcribed and coded using a thematic analysis approach. Physical activity and sedentary behaviour of teachers and children were measured using accelerometers (activPAL<sup>TM</sup> & ActiCal<sup>TM</sup>) during 24 hours of monitoring on five consecutive days. Teachers self-reported their occupational, sport and leisure time physical activity using the Habitual Physical Activity Questionnaire and teachers' productivity was self-assessed using the Health and Work Performance Questionnaire. Teachers' cardiovascular health-status was determined from blood pressure, heart rate, anthropometric measures, demographic data and blood cholesterol, triglyceride and plasma glucose samples. The relationship between active and sedentary behaviour of the teachers and their student's time-matched (63-pairs of data) accelerometer-measured physical activity were also analysed.

The results of this thesis indicated that primary school teachers were more active at work than during out-of-work hours (65% of the energy expenditure was accumulated at work) and 57% of their time at work was spent sitting. In our sample, teachers were

sufficiently physically active during school time to accumulate 30 min of moderate-vigorous activity daily. Teachers' cardiovascular health indicators appeared normal and predicted a low risk of developing cardiovascular disease in the next 10 years (<3%). Teachers with the lowest cardiovascular risk were those that were both more physically active and also interrupted their sedentary behaviour more than four times an hour throughout the day. Although no significant relationship between active and sedentary behaviours of teachers and their students was found, there was a trend for students of more active teachers to be more physically active and spend less time in sedentary behaviour than students of more sedentary teachers.

Using thematic analysis of written transcripts of the principals and teachers interviews it was determined that the two major barriers to teachers not engaging in physical activity at work were lack of time and high workload. Other factors such as weather, classroom space, and the number of children in each classroom, were also identified as barriers to engaging in workplace physical activity.

In conclusion, the work environment in New Zealand primary schools provided an opportunity for teachers to accumulate sufficient physically activity during school time to achieve the minimum daily moderate-vigorous activity recommendation. It is recommended however, that sedentary behaviour be interrupted more than four times an hour throughout the day to reduce the risk of cardiovascular disease among teachers. Further evidence is required to substantiate the recommendation of interrupting sedentary behaviour in the workplace.

# CHAPTER 1: Introduction

## 1.1. Background

The prevalence of non-communicable diseases has been steadily increasing in developed countries (60% of global mortality) (W.H.O., 2004). In 2004, the World Health Organisation (W.H.O., 2004) adopted a Global Strategy on Diet, Physical Activity and Health in response to this public health issue and the goal of decreasing the prevalence of risk factors associated with non-communicable diseases was instigated. The global strategy was based on evidence that the justify actions necessary to meet the challenges and opportunities for achieving World Health Organisation targets and goals (W.H.O., 2004). The World Health Organisation established a set of principles to reduce population prevalence of non-communicable disease risk factors by taking a life-course perspective that promotes physical activity at work, home and school, while considering the effects of urbanization, city planning, transportation, traffic-safety and accessibility to physical activity during leisure (W.H.O., 2004).

There is a large body of evidence reporting physical activity levels accumulated in a variety of occupational settings (Kaleta & Jegier, 2005; Proper & Hildebrandt, 2006; Ruiz-Tendero, Salinero-Martin, Webster, & Aznar-Lain, 2006; Schofield, Badlands, & Oliver, 2005; Sobti, Cooper, Inskip, Searle, & Coggon, 1997; Steele & Mummery, 2003; Takao, Kawakami, & Ohtsu, 2003; Tudor-Locke, Burton, & Brown, 2009) and during leisure-time (Bruce & Katzmarzyk, 2002; Ku, Fox, McKenna, & Peng, 2006; Laaksonen et al., 2002; Monteiro et al., 2003; Pitsavos, Panagiotakos, Lentzas, & Stefanadis, 2005; Salmon, Bauman, Crawford, Timperio, & Owen, 2000; Vuillemin et al., 2005; Wilcox, Castro, King, Housemann, & Brownson, 2000). Differences in

occupational physical activity intensity and volume exist between workplace settings that can influence an individual's engagement in leisure-time physical activity. Most of the studies to date investigating workplace physical activity have revealed low levels of total physical activity engagement and have led researchers to implement various strategies aimed at reducing physical inactivity for use in specific contexts and settings (Chan, Ryan, & Tudor-Locke, 2004; Cook, Simmons, Swinburn, & Stewart, 2001; Epstein & Roemmich, 2001; Healy et al., 2008; Renaud et al., 2008) by increasing workplace physical activity (Aittasalo & Miilunpalo, 2006; Beers, Roemmich, Epstein, & Horvath, 2008; Benedict & Arterburn, 2008; Bravata et al., 2007; Campbell et al., 2002; Cheung & Chow, 2006; Dishman, DeJoy, Wilson, & Vandenberg, 2009; Dishman, Oldenburg, O'Neal, & Shephard, 1998; Eves & Webb, 2006; Murphy, Murtagh, Boreham, Hare, & Nevill, 2006; Mutrie et al., 2002; Proper et al., 2006; Prosser, Thomas, & Darling-Fisher, 2007; Renaud et al., 2008; Thomas & Williams, 2006; White & Ransdell, 2003).

There is an association between physical inactivity and mortality from non-communicable diseases (Katzmarzyk, Church, Craig, & Bouchard, 2009) and modifying physical activity behaviours could act as a preventative measure (W.H.O., 2004). Physical inactivity is the fourth leading cause of death worldwide yet the protective effects of physical activity are under-utilised and the cost burden of physical inactivity is mostly ignored by public health officials (Kohl et al., 2012).

It has been demonstrated that sedentary and physical activity behaviours have different physiological effects and implications for health (Hamilton, Hamilton, & Zderic, 2007).

Recent evidence has determined that sedentary behaviour was directly associated with a higher risk of mortality due to cardiovascular problems, cancer and other causes, independent of leisure time physical activity (Katzmarzyk et al., 2009). Compliance with the recommendations of accumulating more than 150 min/week of moderate aerobic physical activity in 10 min bouts (W.H.O., 2010) may not ensure protection from non-communicable diseases, which may also depend on a reduction in the time spent in sedentary activities (Hamilton et al., 2007). Therefore, those who spend many hours a day sitting during work or leisure time may be at greater risk of developing non-communicable diseases (Hamilton, Healy, Dunstan, Zderic, & Owen, 2008). To explain the independent associations of physical activity, sedentary behaviour and physical inactivity with non-communicable diseases it may be necessary to measure sedentary behaviour separately from physical activity.

The prerequisite is that researchers understand factors that influence habitual activity before we can design and implement effective intervention strategies to increase physical activity levels and reduce sedentary behaviour. The overarching question for this thesis was “How does the work environment affect physical activity, sedentary behaviour and cardiovascular health in primary school teachers?” In addition, is there a relationship between teachers’ physical activity and sedentary behaviour and their student’s school-based physical activity?

## **1.2. Rationale**

### *Why the workplace?*

It is generally accepted that health benefits and quality of life are associated with an active lifestyle (Salmon, 2001). The workplace is a setting where people spend at least one-third of the day (Smith, Conway, & Karsh, 1999). In a study of university workers it was reported that during waking hours, workers spent about 60% of the day in sedentary activities (Ruiz-Tendero et al., 2006) expending ~80 kcal per hour of sedentary activity. Levine et al. (Levine, 2002, 2007; Levine et al., 2008), contend that a change in employees habits in their workplace is required to increase daily energy-expenditure to either maintain or lose weight or to improve their general state of health. Adults expend energy through purposeful exercise, changes in postural position and non-exercise activity thermogenesis (NEAT) described by Levine and colleagues (Levine et al., 2005), as the physical activity performed during the routines of daily life. Small increases in the volume of light physical activity throughout the day can increase non-exercise activity thermogenesis and total daily energy-expenditure (Levine et al., 2005).

Depending on the occupation, workers may spend long periods of time seated, and a large proportion of these individuals do not compensate for this inactivity by engaging in higher intensity activities during leisure time (Jans, Proper, & Hildebrandt, 2007). Legislators, senior managers, clerks, and those working in scientific and artistic professions spend more time sitting than the average worker. Hamilton et al. (Hamilton et al., 2008) identified that people who work in a sitting position for prolonged periods have double the risk of developing cardiovascular disease compared with those individuals who have physically active jobs.

The workplace has been recognized as an excellent research setting for the study of physical activity, sedentary behaviour, physical inactivity and health (Dishman et al., 1998) as well as a convenient site to implement intervention strategies to increase habitual physical activity (Plotnikoff, McCargar, Wilson, & Loucaides, 2005). In this thesis work-related physical activity of teachers and time spent sitting during work hours were quantified.

### *Why primary school teachers?*

Currently, half of the adult population in New Zealand do not meet the 150 min per week moderate activity guideline, nearly two thirds are overweight or obese and there are greater proportions of overweight individuals in the working population (Ministry of Health, 2012). According to LaMaster et al. (LaMaster, McKenzie, Marshall, & Sallis, 1998), primary school teachers from the United States were identified as an at risk group with 68% of the teacher's school-day energy expenditure accrued during non-school hours indicating that work hours are predominantly sedentary. There is little information regarding teachers physical and sedentary behaviours during school hours, whereas there is ample descriptive data of children's activity at school (Berkey, Rockett, Gillman, & Colditz, 2003; Cale & Harris, 2006; Fox, Cooper, & McKenna, 2004; Salmon et al., 2005; St Leger, 2004), activity of educators or non-academic staff in university settings (Castillo, Cruz, Garcia, Jaque, & Morales, 2010; Cerecero, Hernández, Aguirre, Valdés, & Huitrón, 2009; Roldán Aguilar, Lopera Zapata, Londoño Giraldo, Cardeno Tejada, & Zapata Vidales, 2008; Ruiz-Tendero et al., 2006; Uribe Velez et al., 2010) and tertiary students physical activity (Lee, 1992; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). Teachers occupational physical activity behaviours has received scant attention from researchers (St Leger, 2004; Till, Ferkins,

& Handcock, 2011). The studies in this thesis were designed to provide a comprehensive profile of primary school teachers' work-related physical activity and sedentary behaviours.

#### *Why sedentary behaviour?*

The study of sedentary behaviour and its implications for health is an emerging area of research. More research is required to understand how sedentary behaviour affects population health (Hamilton et al., 2008). What has become clear in recent research is that sedentary behaviour requires special consideration owing to its unique characteristics, which are distinct from the benefits of physical activity (Hamilton et al., 2007). In this thesis, the effects of occupational physical activity, sedentary behaviours and the physical activity of primary school teachers on their health were examined.

#### *Why odds ratios as relative risk?*

Odds ratios are a measure of the size of an effect, allowing examination of the factors that influence the magnitude of an effect, which is determined by the quotient between the numbers of times that an event occurs versus how often it does not occur (Martin & Altman, 2000). An aim of this thesis is to estimate the effect of physical activity and sedentary behaviours on teachers' cardiovascular-risk factors. Odds ratios have been shown to be good measure of the size of an effect (Davies, Crombie, & Tavakoli, 1998). Unfortunately, the odds ratios do not approximate well the relative risk when the initial risk is high and therefore odds ratios should not be interpreted as equivalent to relative risk (Davies et al., 1998). Nevertheless for this cohort study, odds ratios were an



appropriate method to investigate factors that influence cardiovascular risk in primary school teachers (Davies et al., 1998).

#### *Why dichotomise data in to lower and higher deciles?*

Dichotomising the teachers' data into higher or lower decile schools may be problematic because the socio-economic status of the mid-decile schools 5 and 6 are not very different. According to Altman & Royston (Altman & Royston, 2006) dichotomising is a common approach for use in studies with small sample sizes. Discarding data from the mid-decile schools is not recommended as the statistical power to detect a relationship is reduced (Altman & Royston, 2006). Nevertheless, there was only one school from each 5 and 6 decile schools and removing that data would have made no difference to the results.

#### *Why cardiovascular risk profile?*

Cardiovascular diseases (CVD) are one of the main causes of death in New Zealand (Ministry of Health, 2003). The teaching profession is considered as an occupation of low physical demand (LaMaster et al., 1998). It is well documented that low levels of habitual physical activity and high proportions of sedentary behaviour contribute significantly to an increased risk of developing cardiovascular and other non-communicable diseases (W.H.O., 2010). In this thesis, the effects of teachers' work-related physical activity and sedentary behaviours on cardiovascular risk factors were examined.

### *Why productivity?*

Health status is one of the main variables that affect workers' productivity (Kessler et al., 2003). Teachers productivity was scored with self-reported absenteeism in hours lost over the school week and presenteeism using a 10-point Likert scale, which is a self-assessed measure of job performance where 1 = worst and 10 = top performance (Kessler, Petukhova, & McInnes, 2007). The aim of this study was to determine teachers' presenteeism and absenteeism, and assess whether accelerometer measured physical activity and sedentary behavior influence productivity using the Health and Work Performance Questionnaire (Kessler et al., 2007).

### *Definitions*

- Physical activity, according to Caspersen et al (Caspersen, Powell, & Christenson, 1985), is “any bodily movement produced by skeletal muscles that resulting in energy expenditure above the resting level”, usually over 1.6 metabolic equivalent units (MET) (Pate, O'Neill, & Lobelo, 2008).
- Active living is a way of life that integrates physical activity into daily routines (Cavill, Kahlmeier, & Racioppi, 2006).
- Physical inactivity is defined as an absence of physical activity or exercise (W.H.O., 2010).
- Sedentary behaviours are those activities involving low energy expenditure above resting level (Biddle, Gorely, Marshall, Murdey, & Cameron, 2004),  $>1.0$  to  $\leq 1.5$  MET (Pate et al., 2008). In this work, the definition of sedentary behaviour proposed by the Sedentary Behaviour Research Network was adopted for all analysis: “*sedentary behaviour is defined as any waking behaviour*

*characterized by an energy expenditure  $\leq 1.5$  MET while in a sitting or reclining posture” (SBRN, 2012).*

### **1.3. Thesis significance and originality**

This is the first study to quantify New Zealand primary school teachers’ physical activity and sedentary behaviour in the workplace. This is also the first study to use objective measures (accelerometers and activity monitors) to assess teacher’s workplace physical activity, self-report their occupational, sport and leisure time physical activity using the Habitual Physical Activity Questionnaire and assess their productivity using the Health and Work Performance Questionnaire. In addition, this is the first study that examined the relationship between teachers’ and their student’s physical activity.

### **1.4. Thesis question**

Does the work environment affect the cardiovascular risk profile, physical activity and sedentary behaviours of primary school teachers, which may affect their students’ school-based physical activity?

### **1.5. Thesis aims**

Aim 1: To determine teachers’ perceptions of barriers and facilitators of physical and sedentary activity levels at work.

Aim 2: To assess teachers’ physical and sedentary activity levels at work using both objective and subjective measures.

Aim 3: To evaluate associations between physical activity and sedentary behaviour and cardiovascular risk factors.

Aim 4: To examine the relationship between teachers' activity levels and their students' activity levels.

### **1.6. Overview of the studies undertaken**

Study 1 determined teachers' perceptions of barriers and facilitators to physical activity at school. Study 2 quantified teachers' physical and sedentary activity and examined their productivity at school. In addition, blood samples were drawn to determine the cardiovascular risk of teachers. Study 3 matched teachers' and their student's accelerometer measured physical activity behaviours to determine whether physical activity of teachers influences their student's activity levels during school time.

A summary of each study is provided below:

Study 1: Identifying barriers and facilitators of teachers' physical activity at school.

In this qualitative study, semi-structured interviews with school principals and primary school teachers were conducted to gain insight into teachers' perceptions of facilitators and barriers to physical activity at school, and to understand workplace routines, the internal culture of schools, individual teaching styles and role modelling.

In order to achieve Aim 1 of the thesis Study 1 was designed to answer the following questions:

1. What do teachers think and know about physical activity in their workplace?
2. What are the routines and organisational culture in primary schools that support workplace physical activity?
3. What are the facilitators and barriers to altering the volume and intensity of teachers' occupational sedentary behaviour and physical activity?

Study 2: Effect of teachers' work-related sedentary and physical activity on cardiovascular risk and productivity

In Study 2 primary school teachers' physical activity and time spent in sedentary activity during school days were measured objectively using ActiCal<sup>TM</sup> accelerometers and activPAL<sup>TM</sup> activity monitors. Anthropometric data and blood profiles were also collected to determine cardiovascular risk.

In order to achieve Aim 2 and Aim 3 of the thesis Study 2 was designed to answer the following questions:

1. What are the teachers' physical and sedentary activity levels as determined by the accelerometer and step count data?
2. Do teachers meet the physical activity recommendations?
3. What is the amount of time spent in sedentary, light, moderate and vigorous activity during the day?
4. What percentage of sedentary activity is spent sitting versus standing?

5. What is the relationship between teachers' cardiovascular risk and their physical activity and sedentary behaviours?
6. What are teachers' perceived work productivity and occupational, sport and leisure time physical activity levels?

Study 2 provided quantitative data on teachers' actual sedentary and physical activity during school hours. Previous research identified that teachers' energy expenditure during work hours is low, but recent changes in teaching styles may have increased workplace physical activity. Presently, there is no information on the magnitude of primary school teachers' occupational physical activity and sedentary behaviours.

Study 3: Comparison of teachers' and their students' physical and sedentary activity patterns

In Study 3 comparisons were made of teachers and their student's objectively measured sedentary and physical activity during school hours using Actical<sup>TM</sup> accelerometers and activPAL<sup>TM</sup> activity monitors. The aim of this study was to investigate the relationship between sedentary and physical activity behaviour of teachers and their students.

In order to achieve Aim 4 of the thesis Study 3 was designed to answer the following questions:

1. Is there a relationship between teachers' and their students' physical and sedentary activity patterns?

2. Do teachers' sedentary activities influence their students' physical and sedentary activity patterns at school?

### **1.7. Thesis organisation**

This thesis was structured in seven chapters (Figure 1), following a traditional format. The preliminary chapters of the thesis consist of an overview of occupational physical activity and sedentary behaviours related to health (Chapter 1) and two reviews (Chapter 2 and 3). The first review evaluated measurement techniques and instruments to assess physical activity and sedentary behaviour in the workplace and informed the best measurement strategy to use in this thesis. The second review examined the existing literature on active and sedentary behaviours and the health status of teachers to identify future research directions. The evidence presented in Chapter 1-3 identified that teachers daily energy-expenditure was low owing to the fact that workplace hours are predominantly sedentary, which potentially increase their risk of developing cardiovascular diseases. The following Chapters (4-6) consist of the methods, results and discussion of three studies that provide an in depth analysis of the teachers' work-related sedentary and physical activity behaviours and the effect on teachers' cardiovascular health and their students' school-based physical activity.

Chapter 4 of the thesis details all methodological aspects, including the selection of participants, the data collection process, a description of measurements, instruments, and the analysis of the information and data collected in Studies 1-3. Chapters 5 and 6 of the thesis are devoted to reporting the results of Studies 1-3, and discussion of the findings presented as recommendations and conclusions. Additional information,

related to official documents, information and invitation letters and copies of measurement instruments (questionnaires) are included at the end of this thesis in the appendices.

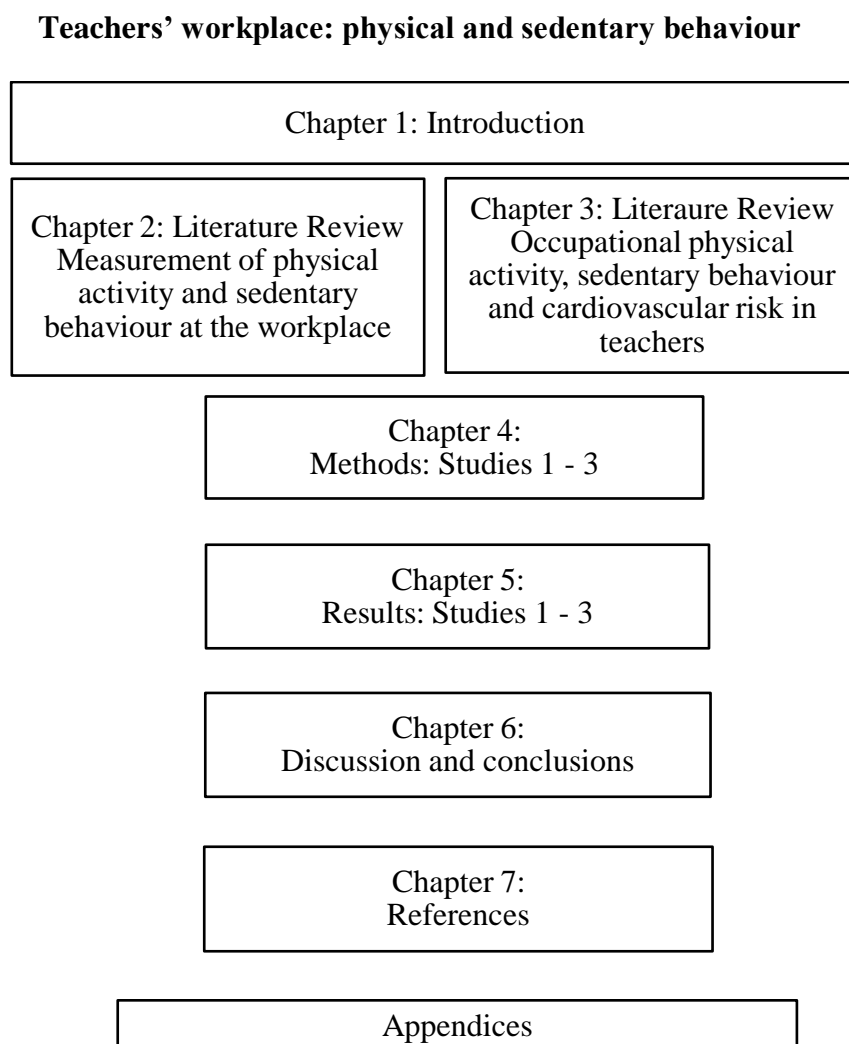


Figure 1: Schematic of the thesis structure



## CHAPTER 2

### Literature review I: Measurement of physical activity and sedentary behaviour at the workplace

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#### **2.1. Introduction**

Adults spend at least one-half of their waking hours working, and occupational activity is becoming more sedentary (Smith et al., 1999). Marshall (2004) reported that there was a linear relationship between sedentary behaviour and absenteeism. The main reason for absenteeism was the presence and prevalence of metabolic disorders and mental illness associated with work-related sedentary activity. Modern work environments are both more competitive and stressful with less physical activity and more sedentary behaviour during work hours.

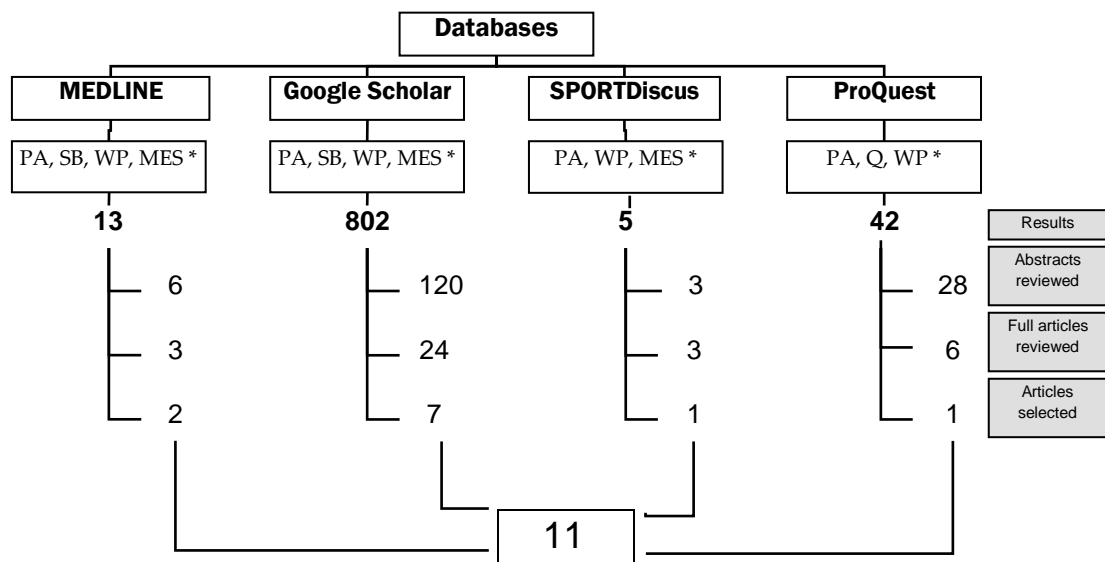
Workplace sedentary behaviour is not simply the absence of physical activity but generally involves intellectual processing that requires little movement and low energy expenditure (Jamner & Cooper, 2002; Reilly et al., 2008). In several studies significant relationships were identified between less habitual physical activity and more sedentary behaviour with obesity and cardiovascular risk-factors or disease (Blair & Brodney, 1999; Eves, Webb, & Mutrie, 2006; Healy et al., 2008; Mummery, Schofield, Steele, Eakin, & Brown, 2005; Schneider, Crouter, Lukajic, & Bassett, 2003).

The impact of occupation on lifestyle diseases is an emerging field of research. Independent of time spent in physical activity, there were significant negative associations of mean activity intensity, and time spent in sedentary and light intensity activity associated with waist circumference and the clustering of metabolic risk factors (Healy et al., 2008). Too much time sitting is a health risk (Hamilton et al., 2007) independent of whether the individual is engaging in the recommended levels of daily physical activity (Healy et al., 2008) and interrupting sedentary time could improve health (Beers et al., 2008; Healy et al., 2008; McAlpine, Manohar, McCrady, Hensrud, & Levine, 2007). The workplace has been recognised as an important setting for the promotion of physical activity among adults (Plotnikoff, Prodaniuk, Fein, & Milton, 2005) owing to the proportion of time spent at work and the importance of work to an individual's identity, social status, health and economic well-being (Batt, 2009). The workplace may play an important role in the prevention of obesity and other lifestyle diseases if an appropriate physical activity intervention can be implemented at work sites (Eves et al., 2006; Mummery et al., 2005).

In order to assess the effectiveness of intervention strategies to prevention chronic disease, the tools and techniques used to measure physical activity and sedentary behaviour must be valid, reliable, and practical (Sirard & Pate, 2001). Therefore, the main aim of this review was to identify methods used to measure physical activity and sedentary behaviour in the workplace and determine the strengths and limitations of the different tools. We report on studies that use objective, subjective and criterion standard approaches to measure workplace physical activity and sedentary behaviour.

## 2.2. Methods

Databases were searched for relevant published articles including MEDLINE via PubMed, SPORT Discus, ProQuest and Google Scholar. Keywords and combinations of them were used for the search including physical activity, workplace, sedentary behaviour, measurement and questionnaire. To meet inclusion criteria journal articles had to be written in English, published between 1990 and 2009 that measured both workplace physical activity and sedentary behaviour using motion sensors, indirect calorimetry or validated questionnaire. After applying the inclusion criteria, eleven studies were selected (Figure 2) and data were extracted according to the methods identified by Hartvigsen et al. (2000) (Tables 2-4): year of publication, name of the authors, title of article, source, testing methods, intervention context, data collection method and occupational groups or type of work under study.



\* PA: physical activity, SB: sedentary behaviour, WP: workplace, MES: measurement, Q: questionnaire.

Figure 2: Search strategy

The analysis was conducted according to the classification of measurement techniques developed by Sirard & Pate (Sirard & Pate, 2001) into objective measures (motion sensors: accelerometers, pedometers), subjective measures (self-reports: interviews, surveys and questionnaires) and criterion standard measures (indirect calorimetry).

### 2.3. Results

Searches of databases identified 862 potentially relevant articles. Of these, 157 full articles were downloaded based on the information provided in the abstracts and 36 articles were identified for a detailed review. From these, 11 articles were selected based on the inclusion criteria. All articles included in the review measured physical activity and sedentary behaviour at a real or simulated workplace. Questionnaires were the most common tool used to measure physical activity at work followed by motion sensors, and indirect calorimetry (Table 1).

Table 1: Data collection methods and administration

Measurement	Mode	Articles (%)	References
Motion sensors	Accelerometers	9	Ruiz-Tendero et al, 2006
	Pedometers	18	Gilson, 2008; Schofield et al., 2005
	Face to face	9	Kaleta et al., 2007
Questionnaires	Telephone	18	Mummery et al., 2005; Kruger et al., 2006
	Self report	18	Spittaels et al., 2007; Steele and Mummery, 2003
Indirect calorimetry	Laboratory	28	McAlpine et al., 2007; Levine and Miller, 2007; Beers et al., 2008

Studies were grouped into three categories (Tables 2-4): workplace activity measured with motion sensors, workplace activity estimated with questionnaires and laboratory settings with simulated work activities measured using indirect calorimetry.

### *Objective measures*

Researchers frequently use objective measures, accelerometers and pedometers, in physical activity studies. Accelerometers are electronic devices that measure accelerations produced by body movement. Piezoelectric transducers and microprocessors in accelerometers convert recorded accelerations into a quantifiable digital signal referred to as ‘counts’ (a numerical value proportional to the magnitude of the accelerations) (Sirard & Pate, 2001). Pedometers are simple electronic devices used to estimate the number of steps accumulated by detecting vertical displacement of the pelvis at each stride during walking or running.

Recent research has established a link between health-risk factors, physical activity and sedentary behaviour (Gilson, 2008; Healy et al., 2008). For example, accelerometers are able to assess incidental physical activity to provide information about the volume and intensity of physical activity associated with beneficial effects on metabolic risk factors (insulin, leptin, glucose, triglycerides) (Gilson, 2008; Healy et al., 2008).

Data from accelerometers can be used to assess difficult-to-capture light intensity physical activity, which is typically incidental in nature and rarely assessed when self-report instruments are used (Sirard & Pate, 2001). Motion sensors do not always detect arm and some upper body movements as the devices are generally worn on the waist (Trost, McIver, & Pate, 2005). Low cost pedometers provide real-time information of step counts to participants, which may motivate them to be physically active (Tudor-Locke et al., 2004). Accelerometers are a more sophisticated version of the pedometer but generally do not provide participants with real time activity data but information on

intensity, duration and frequency of activity can be downloaded with manufacturer software (Trost et al., 2005). Overall, motion sensors are widely used in research and offer good reliability and validity when validated against criterion standards (see Table 5).

Two of the three studies shown in Table 2 measured 3-7 days of physical activity in workplace settings using pedometers. There was a significant inverse relationship between workday step counts and sitting time associated with waist circumference and blood pressure (Gilson, 2008). Blue-collar workers (mechanics, green keepers, dry cleaners) accumulated more steps (70%) than other occupations studied (Schofield et al., 2005). The steps university academics took during work hours were  $4,400 \pm 1,400$  (mean  $\pm$  SD) compared with  $10,300 \pm 5,500$  steps for blue-collar workers (Schofield et al., 2005).

Table 2: Objective measurement of physical activity at the workplace

Author	Sample	Measure	Instrument	Method	Results
Gilson, (Gilson, 2008)	n = 216 (20% men)	Steps / day for 7 days	Pedometer Yamax SW 200	Record consecutive step counts for five working days, also at the weekend.	Daily step counts were inversely associated with sitting time ( $p < 0.05$ ) Barcelona employees sat less ( $p < 0.001$ ), men's and women's waist circumference ( $p < 0.01$ ) and women's diastolic blood pressure ( $p < 0.001$ ) were lower.
Ruiz –Tendero et al., (Ruiz-Tendero et al., 2006)	n = 47 (36% men)	Min light, moderate and vigorous physical activity	MTI Actigraph	The monitor was worn during waking hours for 7 consecutive days, with a minimum of 10 hours of data per day.	Mean accelerometer counts registered on workdays was 450,000 counts/day Sitting during working hours was 20% (cleaners), 60% (researchers), and 60% (administration and services staff)
Schofield et al., (Schofield et al., 2005)	n = 181 workers (33% men)	Steps / day at work and non- work settings	Pedometers Digiwalker SW-700	Participants used a pedometer over a consecutive 3-day working period, during work and non-work time.	Women had higher non-work steps, men had higher work steps. 43% achieved 10,000 steps/day. Large difference in pedometer steps by occupational category, Blue-collar workers accumulated 70% more steps than other occupations studied.
Spittaels et al. (Spittaels, De Bourdeaudhuij, Brug, & Vandelanotte, 2007)	n = 526	Job related physical activity	MTI Actigraph	Measured at baseline and at 6 months follow up, in one of six worksites.	Accelerometer moderate and vigorous physical activity (min/week) at baseline $330 \pm 170$ (mean $\pm$ SD); 6 months follow up $340 \pm 160$ 30 min of physical activity on 65% of days
Steele & Mummery (Steele & Mummery, 2003)	n = 90	Job related physical activity	Yamax Digiwalker SW-700	Average steps of 3 working days	Mean daily pedometer step counts for professional ( $2,800 \pm 950$ ), white-collar ( $3,600 \pm 1500$ ) and blue-collar workers ( $8,800 \pm 2500$ )

Ruiz-Tendero et al. (2006) used accelerometers (MTI Actigraph) found that approximately 50% of the university workers attained moderate-to-vigorous intensity (MVPA, >1953 counts/min) for at least 30 min on five or more days of the week and steps taken during weekdays were  $14,300 \pm 4,300$  (mean  $\pm$  SD). Typical total accelerometer counts of approximately 450,000 were accumulated on workdays, and cleaners, researchers and administration and service staff sitting time during working

hours was 20%, 60% and 60% respectively. (Ruiz-Tendero et al., 2006). Overall, in the studies reviewed nearly 60% of adults waking hours were spent in sedentary activities.

### *Subjective measures*

The most common method used to measure physical activity was subjective, which relies on participants recalling previous physical activity participation (Blair & Brodney, 1999). In this review, subjective measures include self-reports via interviews, surveys and questionnaires. A survey is a *“technique of descriptive research that seeks to determine present practices or opinions of a specified population; can take the form of a questionnaire, interview, or normative survey”*, whereas a questionnaire is a *“type of paper-and-pencil survey used in descriptive research in which information is obtained by asking participants to respond to questions rather than by observing their behaviour”* (Thomas, Nelson, & Silverman, 2005). An interview is a survey technique similar to the questionnaire except that participants are questioned and respond orally rather than in writing (Thomas et al., 2005).

Subjective assessments of physical activity are an efficient method for large population studies and have been used in the workplace without significant disruption to work duties (Mummery et al., 2005). Researchers have used subjective measures to provide information about the behavioural and psychological variables related to occupational physical activity and sitting time. Self-reported physical activity research has allowed large-scale trends in active and inactive behaviours in the workplace to be analysed (Cooper et al., 2009).



The studies shown in Table 3 report physical activity and sedentary behaviour in terms of mean occupational sitting time, estimated energy expenditure (expressed in MET) and time spent being physically active at work and during leisure time. Mummery et al. (2005) used a survey of workers in two Australian regional communities and determined that mean occupational sitting time was  $>3$  h/d and that men spent more time sitting than women (210, 190 min respectively;  $p=0.026$ ). There was a significant association between occupational sitting time and  $\text{BMI} \geq 25$  for men but not women. In contrast, Kaleta et al. (2007), using a questionnaire (Seven Day Physical Activity Recall) determined that weekly energy expenditure of occupational physical activity ( $<4,000$  kcal/week) was not related to  $\text{BMI} \geq 25$ . Spittaels et al. (Spittaels et al., 2007) used the International Physical Activity Questionnaire (IPAQ) to determine that work-related physical activity was  $160 \pm 300$  min/week (mean  $\pm$  SD).

A comparison of occupational physical activity (OPA) at light, moderate and heavy intensity within different work-sectors determined that white-collar workers (clerical salesmen and service workers) spent an average 80% of work hours performing “light” activities ( $< 3$  MET) (Steele & Mummery, 2003). Blue-collar workers spent 20% in “light”, 60% in “moderate” (3-6 MET) and 20% in heavy ( $>6$  MET) intensity occupational activities.

Table 3: Subjective measurement of physical activity at the workplace

Author	Sample	Measure	Instrument	Method	Results
Mummery et al. (Mummery et al., 2005)	n = 1,579 full-time employee	Workplace sitting time (min)	Survey, self-report	Telephone survey with 98 questions in four sections: occupation, leisure time physical activity, BMI, and workplace sitting time	Mean workplace sitting time was > 3 h/d, for men than women Significant association between workplace sitting time and men's BMI $\geq 25$ only
Kaleta et al. (Kaleta, Makowiec - Dabrowska, & Jegier, 2007)	n = 508 full-time employee	Workplace energy expenditure	Recall	7 Day Physical Activity Recall	Weekly workplace energy expenditure not related to BMI $\geq 25$
Kruger et al. (Kruger, Yore, Ainsworth, & Macera, 2006)	n = 6,360	Sedentary time	Survey	National Physical Activity and Weight Loss Survey (NPAWLS)	55% of men and 70% of women had sedentary (sit/stand) work. 26% of men and women have walking-related occupations. 20% of men and 7% of women engaged in heavy labour. Percent men with normal BMI for sitting/standing occupations, 31%, and 37% for heavy labour occupations. 53% of women in heavy labour occupations had a normal BMI. Total physical activity (baseline) $650 \pm 470$ min/week (mean $\pm$ SD). Moderate and vigorous intensity physical activity $390 \pm 330$ min/week. 30 min of physical activity on 65% of days Mean job-related physical activity (min /week) baseline $160 \pm 300$ ; 6 month follow up $160 \pm 290$ .
Spittaels et al. (Spittaels et al., 2007)	n = 526	Job related physical activity	IPAQ	Fill out IPAQ (long version) at baseline and at 6 months follow up in six worksites.	Professionals work 60–80 hours per week Professionals and white-collar workers spend 80% of work time in light activities (<3 MET). Blue-collar workers spent 20% in light, 60% in moderate (3-6 MET) and 20% in heavy (>6 MET) occupational activities.
Steele & Mummery (Steele & Mummery, 2003)	n = 90	Occupational Physical activity	TOQ, OPA	Tecumseh Occupational Physical Activity Questionnaire (TOQ), Past year Occupational Physical Activity (OPA)	Professionals work 60–80 hours per week Professionals and white-collar workers spend 80% of work time in light activities (<3 MET). Blue-collar workers spent 20% in light, 60% in moderate (3-6 MET) and 20% in heavy (>6 MET) occupational activities.

Subjective assessments ascertain information of the relationship between population level physical activity and demographic, socio-economic, and health-risk behaviours.

Kruger et al. (2006) contacted a nationwide sample of 6,360 workers by telephone whom completed the National Physical Activity and Weight Loss Survey and determined that over half the working population described their work as sedentary (55% of men and 70% of women) and 19% of men and 7% of women performed heavy manual-labour. The researchers also observed that men and women employed in occupations involving heavy labour were twice as likely to engage in regular leisure-time moderate intensity activity compared to those who were mostly sedentary at work. Kaleta et al. (2007) analysed the relationship between BMI > 25 in men and demographic variables and identified that age (> 45 years), lack of recreational physical activity, low educational qualifications, low income and a history of smoking were associated with high BMI.

#### *Measurement of workplace physical activity with criterion standards*

Criterion standards include direct observation, doubly labelled water (DLW), and indirect calorimetry. Direct observation involves witnessing physical activity behaviour and simultaneously recording activity in a written coded format or entering activity codes into a portable computer (Kohl, Fulton, & Caspersen, 2000). Doubly labelled water is a technique that assesses total caloric expenditure by calculating carbon dioxide production using isotope ( $^2\text{H}_2^{18}\text{O}$ ) dilution measured in urine samples for a minimum of 3 days. Open-circuit indirect calorimetry measures energy expenditure (EE) from oxygen consumption ( $\text{VO}_2$ ) and carbon dioxide ( $\text{CO}_2$ ) production. Criterion standard measures provide valid, reliable and highly accurate information about energy expenditure sufficient to detect small changes in the variables studied. The disadvantages of criterion standards are that measurements are either only practical for small samples of the population, measured over a short timeframe or are impractical for use in free-living conditions. Criterion measures are more costly in terms of

implementation and time, for both the investigators and participants because equipment is either expensive or requires sophisticated analyses (Ainslie, Reilly, & Westerterp, 2003). Measurement of activity using indirect or direct calorimetry is only feasible in certain occupations because the measurement equipment could disrupt productivity or modify work-related activity (Ainslie et al., 2003).

The three studies, shown in table 4, measured workplace energy expenditure with indirect calorimetry. At an experimental office facility it was demonstrated that office workers could perform office duties while performing a workout on a stepper, which increased office-work energy expenditure while sitting from  $90 \pm 20$  kcal/h (mean  $\pm$  SD) to  $380 \pm 120$  while simultaneously using the stepper ( $p < 0.001$ ) (McAlpine et al., 2007). Beers et al. (Beers et al., 2008) measured energy expenditure while performing clerical work using indirect calorimetry and reported a trivial increase in energy expenditure between participants sitting on a therapy ball or standing compared with sitting on an office chair. The increase in energy expenditure of stationary workplace-walking while performing office duties ranged from  $120 \pm 25$  kcal/h (Levine & Miller, 2007), (walking on a treadmill while working) to  $290 \pm 100$  kcal/h (McAlpine et al., 2007) (using stepping device while working) compared to sitting. Levine and Miller (Levine & Miller, 2007) suggested that the increase in energy expenditure of walking on a treadmill while doing office work, if other components of energy balance remain constant, could translate into body weight loss of 20-30 kg in 12 months.

Table 4: Criterion standard measurement of physical activity at the workplace

Author	Sample	Measure	Equipment	Setting / Tests	Results
McAlpine et al. (McAlpine et al., 2007)	n=19 10 obese; 9 normal weight healthy sedentary volunteers	Office-work Energy Expenditure	Indirect Calorimetry	Experimental office facility. Energy expenditure 20 min in each condition: lying and standing motionless, Office-work sitting, Office-work walking on OPSD <sup>a</sup> stepper	Resting energy expenditure less in the normal weight than in the obese volunteers ( $r = 0.78\%$ ; $p < 0.001$ ) Linear relationship between walking speed and energy expenditure ( $r^2 = 0.99$ ) Using OPSD stepper while working associated with $290 \pm 100$ kcal/h (mean $\pm$ SD; $p < 0.001$ ) increase in energy expenditure
Beers et al. (Beers et al., 2008)	n = 24 (50% men) sedentary clerical occupation	Office-work Energy Expenditure	Indirect calorimetry	Office workplace Energy expenditure 20 minutes in each condition: word processing; sitting in an office chair, sitting on a therapy ball and standing.	Energy expenditure increased 4 kcal/h ( $p < 0.05$ ) while sitting on a therapy ball No difference in energy expenditure between sitting on a therapy ball or standing postures ( $p = 0.48$ )
Levine & Miller (Levine & Miller, 2007)	n = 15 obese sedentary individuals	Office-work Energy Expenditure	Indirect calorimetry	Experimental office facility Energy expenditure 20 min in each condition: lying and standing motionless, office-work sitting, office-work while treadmill walking	The energy expenditure while seated at work in an office chair was $70 \pm 10$ kcal/h. The energy expenditure while walking and working on a self-selected velocity of $1.1 \pm 0.4$ mph was $190 \pm 30$ kcal/h.

<sup>a</sup>OPSD = Office Place Stepping Device

### *Validity and reliability of instruments*

The reviewed studies did not report on the validity of the instruments used. However, most instruments shown in Table 5 had acceptable levels of validity with a range of  $r = 0.50$  to  $r = 0.96$ . Most of these instruments demonstrated adequate validity against a gold standard in both laboratory and field conditions. Surveys, questionnaires and / or interviews with acceptable levels of reliability were the measurement instrument most

used by researchers (Kaleta et al., 2007; Kruger et al., 2006; Mummery et al., 2005; Spittaels et al., 2007). Motion sensors showed the best validity and reliability over subjective measures, highlighting the accelerometer's accuracy and reliability ( $98.5 \pm 1.0$  % of accuracy and reliability of  $98.8 \pm 1.2$  %). The most measured occupational physical activity behaviours were sedentary time, occupational sitting time, workplace physical activity and walking.

Table 5: Validity and reliability of studies included in this review

Method	Study Authors	Validity of instruments <sup>a</sup>			Reliability		References
		Measurement tool	Validation tool	Finding	Test – retest period	Finding	
Indirect calorimetry	McAlpine et al. (McAlpine et al., 2007)	Indirect calorimeter Columbus	N/A <sup>b</sup>	N/A	N/A	N/A	N/A
	Levine & Miller (Levine & Miller, 2007)	Indirect calorimeter Columbus					
	Beers et al. (Beers et al., 2008)	Indirect calorimeter V <sub>max</sub> 29, Metabolic Cart	vs. Deltatrac Metabolic Monitor (DTC)	t-test $\Delta$ 0.06 (p = 0.8)	1 day	Coefficient of variation 8.0%	Cooper et al. (Cooper et al., 2009)
Motion sensors	Ruiz-Tendero et al. (Ruiz-Tendero et al., 2006)	MTI Actigraph	vs. EE <sup>c</sup>	r = 0.82	Not given	CV <sup>d</sup> 8.9% ICC <sup>e</sup> 0.80	Melanson & Freedson (Melanson & Freedson, 1995)
			vs. VO <sub>2</sub>	r = 0.89			
			vs. Treadmill speed	r = 0.92			
			3 trials of treadmill walking (3 mph)				
	Schofield et al. (Schofield et al., 2005)	Yamax Digiwalker SW 700	Treadmill walking at various speeds – EE by indirect calorimetry	% accuracy $\pm$ 99% p<0.05			Welk et al. (Welk, Schaben, & Morrow, 2004)
			400-m walk		1 – 4 days	Error scores - 0.1 $\pm$ 8.4 95% prediction interval (16.7 – 16.9)	Crouter et al. (Crouter, Schneider, Karabulut, & Bassett, 2003)
		3DPAR, steps/occupational category	Correlated with VO <sub>2</sub> max	r = 0.50 p < 0.001	7 days test retest	r 0.75 p < 0.001	Schneider et al. (Schneider et al., 2003)
	Gilson (Gilson, 2008)	Yamax SW 200	Pedometer versus direct observation	r = 0.96 p = 0.001			Jamner & Cooper (Jamner & Cooper, 2002)
					1 week measuring period	ICC 0.96 (95% CI <sup>f</sup> , 0.94 – 0.97)	Kilanowski et al. (Kilanowski, Consalvi, & Epstein, 1999)
							Barfield et al. (Barfield, Rowe, & Michael, 2004)

Questionnaires	Mummery et al. (Mummery et al., 2005)	Active Australia Survey			14 days	ICC (95% CI) 0.86 (0.80-0.90)	Booth et al. (Booth, Owen, Bauman, & Gore, 1996) Australian Institute of Health and Welfare, (AIHW, 2003)
			Cross validated vs. PSFA <sup>g</sup>	Total time of: Moderate activity r=0. 97 Vigorous activity r=0. 89			
	Kaleta et al. (Kaleta et al., 2007)	7 Day Physical Activity Recall (SDPAR)	Relationship between SDPAR and VO <sub>2</sub> max	r = 0.61 p < 0.05	5 weeks 2 – 9 weeks 5 – 9 weeks	r = 0.58 p < 0.05 r = 0.42 p < 0.05 r = 0.63 p < 0.05	Dishman and Steinhardt (Dishman & Steinhardt, 1988)
	Kruger et al. (Kruger et al., 2006)	National Physical Activity and Weight Loss Survey (NPAWLS)	vs. accelerometer  vs. Physical activity log	k=0.19 CI 0.04, 0.34  k = 0.40 CI 0.15, 0.65	1 – 5 days	k = 0.84 CI = 0.69, 0.99	Yore et al. (Yore et al., 2007)
	Spittaels et al. (Spittaels et al., 2007)	International Physical Activity Questionnaire (IPAQ)	Criterion validity CSA accelerometer)	Long form: p=0.33, 95% CI 0.26-0.39 Short form: p=0.30, 95% CI=0.23-0.36	test – retest between 8 and 10 days	Long form repeatability coefficient p=0.81 (95% CI 0.79 – 0.82); Short form p=0.76 (95% CI 0.73-0.77)	Craig et al. (Craig et al., 2003)
	Steele & Mummery (Steele & Mummery, 2003)	Tecumseh Occupational physical activity Questionnaire (TOQ)	Against Cardiorespiratory fitness and tri-axial accelerometer	EE during work 0.91 Work index 0.86 , p<0.05	1 month	R = 0.80	Philippaerts et al. (Philippaerts, Westerterp, & Lefevre, 2001)

<sup>a</sup>Data from these studies show the instruments reported validity and an assessment of the validity is not included as part of this review

<sup>b</sup>N/A = Not applicable

<sup>c</sup>EE = Energy expenditure

<sup>d</sup>CV = Coefficient of variation

<sup>e</sup>ICC = Intra-class correlation

<sup>f</sup>CI = Confidence Interval

<sup>g</sup>PSFA = Pilot Survey Fitness of Australians



## **2.4. Discussion**

The aim of this review was to summarise methods used to measure workplace physical activity and sedentary behaviour and identify the associated strengths and limitations of different measurement techniques. The world-wide increase in non-communicable diseases affecting working adults (W.H.O., 2010) related to increases in occupational sedentary behaviour (Cook et al., 2001) highlight the need for accurate, valid and reliable measurement instruments (Troost et al., 2005). Evidence from studies in this review identified that: (1) Most workplace research measured physical activity rather than sedentary behaviour; (2) the majority of studies on occupational sedentary behaviour used self-reported assessments; (3) and workplace sedentary activity was considered disproportionate with occupational physical activity.

In studies that measured office-work physical activity using a criterion standard it would appear that being physically active while carrying out office duties is an effective strategy to increase energy expenditure (Beers et al., 2008; Levine & Miller, 2007; McAlpine et al., 2007). All participants tolerated walking on steppers or treadmills at “active” workstations, which may be an effective weightloss approach, and were able to perform all the typical clerical functions including answering phone calls, reading documents, reception duties and typing (Levine & Miller, 2007; McAlpine et al., 2007). Longitudinal studies of the effectiveness of active workstations using treadmills and steppers in a variety of occupational settings are required to ascertain the usefulness of active workstations as a weightloss tool.

Objective measurement using motion sensors are highly reliable method for collecting physical activity information in workplace settings (Cook, Simmons, Swinburn, & Stewart, 2001). Accelerometers allow activity data collection for long periods, and store large amounts of activity information without the presence of a researcher, saving on time and cost (Trost et al., 2005). Another advantage of using objective measures is to reduce error from recall bias (Ainsley et al., 2003) and participants can wear motion sensors in the workplace without interfering with productivity. Only one study assessed the relationship of physical activity with health-risk (Gilson, 2008), therefore further studies that combine measurement of metabolic risk-factors and objectively assessed sedentary behaviours at work are required to determine associations between workplace activity and health. While objective measures are the best option for estimating physical activity and sedentary time, when choosing accelerometers, there is still no consensus around equations used to interpret accelerometer data and decisions made during data reduction and cleaning.

In the studies reviewed, self-report was the most common method for collecting workplace activity data because of the ease of collecting data on large populations and the cost effectiveness of this research method (Ainsley et al., 2003). Self-reports of daily occupational sitting were under reported (3 hours) compared with objective measures of sitting time at work (~5 hours a day). Comparison of physical activity between studies that self-reported minutes spent in occupational physical activity per week and studies that objectively measured activity as steps counts during work hours were not practical. All of the subjectively assessed physical activity studies reviewed measured physical activity patterns at work in relation to BMI, only two assessed

sedentary behaviour measured as sitting time and no studies assessed the relationship of workplace activity with work performance or health outcomes.

### *Gaps in literature*

Studies rarely integrate a both quantitative and qualitative research method, which is necessary to improve our understanding of barriers and facilitators to workplace physical activity behaviours (Proper, Staal, Hildebrandt, van der Beek, & van Mechelen, 2002). Objective and subjective activity measurement techniques combined with measurement of metabolic risk factors would provide researchers with more comprehensive information necessary to develop effective intervention strategies. The relationship between physical activity and sitting time at work with hypertension, dyslipidemia, hyperglycaemia, cardiovascular disease and obesity associated with high health-risk occupations requires further investigation (Welk et al., 2004).

Although using criterion standards to measure activity are not suitable for many work sites, studies in this review verified that simulating work conditions combined with potential intervention strategies could provide important information about potential ways to increase workplace energy-expenditure. The next step is to perform workplace research of strategies that are effective at increasing energy expenditure using objective and subjective measures to validate the long-term worth of the intervention strategies. The measurement error of self-reported physical activity; type, setting, intensity, frequency and duration resulting from participant recall bias, testing, and scoring produce low reliability and validity values for some questionnaires (Macko et al., 2002; Melanson & Freedson, 1995). Therefore, objective tools are recommended to accurately quantify workplace sedentary behaviour and physical activity. However, objectively

measured activity cannot provide information about physical activity; facilitators, barriers, types, and settings, therefore qualitative methods such as questionnaires, interviews or focus groups are necessary to ascertain this information.

Evidence from sedentary behaviour research to date is insufficient to understand fully the relationship between sedentary behaviour and its effects on health or determine the amount of physical inactivity and sedentary activity that is not detrimental to health (Crouter et al., 2003). Sedentary behaviour can affect health as it has been identified that prolonged sitting time was associated with high all-cause death and cardiovascular death, independent of physical activity levels and BMI (Katzmarzyk et al., 2009). Therefore, it is recommended that physical inactivity and sedentary behaviour in the workplace are monitored independent of physical activity.

#### *Limitations of this review*

There were several limitations in this review including the search strategy, which may not have identified all of the studies that measured workplace physical activity and sedentary behaviour. The small number of articles that met our inclusion criteria suggests that further research is required before findings may be generalised to all workplaces, occupations and genders. Studies included in this review used tools with moderate to strong reliability and validity values however, criteria for measuring the included articles' quality were not considered. None of the included studies reported reliability and validity values of the tools used. Studies were excluded that did not clearly state the measurement of workplace physical activity or sedentary behaviour. Future reviews should consider including studies that use the IPAQ (long version) as in this questionnaire participant's self-report time spent in physical activity for occupational, transport and leisure purposes.

## **2.5. Conclusion**

There were a limited number of studies that objectively measured the magnitude of physical activity and sedentary behaviour in the workplace and few that examined the relationship with metabolic risk factors. The validity and reliability of measurement instruments should be included in future studies to ensure confidence in the reported outcomes. Self-reports of physical activity have recall bias therefore motion sensors that independently measure workplace physical inactivity and sedentary behaviour separate from occupational physical activity are recommended. Subjective methods including questionnaires, interviews or focus groups are necessary to determine the facilitators, barriers, and types of physical activity and the settings where activity takes place. The relationship between occupational physical activity and health-risk of workers are different by profession and require independent assessment.

## CHAPTER 3

### Literature review II: Occupational physical activity, sedentary behaviour and cardiovascular risk in teachers

#### 3.1. Introduction

There is a growing concern about physical inactivity and sedentary behaviours associated with a decline in health globally (AIHW, 2003; Cavill et al., 2006; Department of Health and Children, 2009; Livingstone, Robson, Wallace, & McKinley, 2003; Ministry of Health, 2007; Services, 1996). International recommendations for physical activity advocate that adults and children should participate in a minimum of 30 and 60 minutes respectively of moderate-to-vigorous intensity physical activity (W.H.O., 2010) daily during work, transportation, leisure time to prevent chronic disease (Pate et al., 2005). Low physical activity levels are related to the development of chronic diseases (Hamilton et al., 2008; Warren et al., 2010), and the increasingly sedentary lifestyle of population worldwide is associated with considerable economic costs (Bauman et al., 2003). Sitting time is associated with mortality from all causes including cardiovascular disease, independent of leisure-time physical activity (Katzmarzyk et al., 2009), which suggests that the effects of sedentary behaviours on health require further research.

Adults spend more than half of their waking day at work in occupations that require long periods of sedentary activity, which could negatively impact on health, increasing obesity, hypertension, and impaired blood lipids that are associated with cardiovascular

diseases (Grundy, Pasternak, Greenland, Smith, & Fuster, 1999). Other factors such as the environment, socioeconomic status, mood, smoking and alcohol consumption can increase the negative effect on health (Prokosch, Dalleck, & Pettit, 2011).

Teaching is a complex, often stressful and challenging profession, which requires teachers to develop tailored learning and classroom management strategies for a diverse group of students while meeting learning expectations of the curricula and parents (Kent, 2000). Indeed the New Zealand Curriculum seeks to develop key competencies for lifelong learning, based on values and principles that demand from teachers effective pedagogies to promote student learning (Ministry of Education, 2007). Teachers are required to engage with the student as a mentor and guide in the learning process, and be more than a provider of knowledge, which places intellectual, mental and physical demands on teachers. Although teachers' occupational physical activity data is limited other workplace stressors have been identified, including poor working conditions, limited classroom space, poor lighting, noise, and the multiple task requirements of the job (Easthope & Easthope, 2000; Smith & Bourke, 1992). To ensure that the workplace environment does not negatively interfere with student learning teachers' have responded by adapting their teaching style from a sedentary to a more active approach, which may have increased teachers' occupational energy expenditure (LaMaster et al., 1998; Pihl, Matsin, & Jurimae, 2002).

The purpose of this review was to examine the physical and social environmental factors at school that affect teacher's workplace physical activity and sedentary behaviours that may influence their health and their student's physical activity behaviour.

### **3.2. Methods**

CINAHL, EBSCO, Google Scholar, MEDLINE, OSH References, ProQuest, Scopus, Web of Sciences, PsycInfo, Science Direct, and SPORT Discus databases were searched for relevant published articles using the following terms or combinations of the terms; primary, elementary, school teachers, staff, personnel, occupational physical activity, physical fitness, health behaviour, wellness, and role modelling. The criteria for including journal articles were those written in English or Spanish, published 1982-2012 that examined teachers' occupational physical activity, workload, cardiovascular status, or well-being. Articles were excluded that were reviews, meta-analysis or those that were focused on students.

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After applying inclusion criteria, 19 studies were selected and data were extracted according to the criteria identified by Hartvigsen et al. (2000): year of publication, name of the author(s), title of article, source, testing methods, context and focus of study, data collection method and study findings. One study on children's perception of the good teacher was included in the review (Jules & Kutnick, 1997), to obtain information about the teacher as a role model.

### **3.3. Results and discussion**

Searches of databases identified 3,883 potentially relevant articles. Of these, 76 full articles were downloaded based on the information provided in the abstracts and 36 articles were identified for a detailed review. From these, 19 articles shown in Table 6 met inclusion criteria.



**Table 6: Characteristic of the studies reviewed (n = 19): context of study, type of measurement, location, and time of publication**

<i>Characteristics</i>	<i>References</i>	<i>Number (%) of articles</i>
<i>Context of study</i>		
Physical activity and environment	Blair et al., 1984; Brito et al., 2012; Chaiklieng & Suggaravetsiri, 2012; Cheung, Chow, & Parfitt, 2008; Costa & Silva, 2012; da Silva & Almeida, 2012; LaMaster et al., 1998; Messing, Caroly, & Riel, 2011; O'Loughlin, Renaud, Paradis, & Meshefedjian, 1996; Pihl et al., 2002; Sandmark, Wiktorin, Hogstedt, Klenell-Hatschek, & Vingård, 1999; Vaz & Bharathi, 2004; Webber et al., 2012	13 (68%)
Health	Chaiklieng & Suggaravetsiri, 2012; Costa & Silva, 2012; O'Loughlin et al., 1996; Pihl et al., 2002; Virtanen et al., 2007; Webber et al., 2012	6 (32%)
Productivity	Blair et al., 1984; Brien, Hass, & Savoie, 2012; Carson, Baumgartner, Matthews, & Tsouloupas, 2010; Ejere, 2010	4 (21%)
Role model	Cardinal, 2001; Jules & Kutnick, 1997	2 (11%)
<i>Type of measurement</i>		
Questionnaires	Blair et al., 1984; Brien et al., 2012; Brito et al., 2012; Cardinal, 2001; Carson et al., 2010; Chaiklieng & Suggaravetsiri, 2012; Cheung et al., 2008; Costa & Silva, 2012; da Silva & Almeida, 2012; Jules & Kutnick, 1997; LaMaster et al., 1998; O'Loughlin et al., 1996; Pihl et al., 2002; Sandmark et al., 1999; Vaz & Bharathi, 2004; Virtanen et al., 2007	16 (84%)
Objective	Blair et al., 1984; Chaiklieng & Suggaravetsiri, 2012; Cheung et al., 2008; Messing et al., 2011; Pihl et al., 2002; Sandmark et al., 1999; Webber et al., 2012	7(37%)
Survey	Ejere, 2010	1 (5%)
Interview	Jules & Kutnick, 1997; Messing et al., 2011	2 (11%)
Direct observation	LaMaster et al., 1998; Messing et al., 2011	2 (11%)
<i>Location</i>		
North America	Blair et al., 1984; Brien et al., 2012; Cardinal, 2001; Carson et al., 2010; Jules & Kutnick, 1997; LaMaster et al., 1998; Messing et al., 2011; O'Loughlin et al., 1996; Webber et al., 2012	9 (47%)
South America	Bruto et al., 2012; Costa & Silva, 2012; da Silva & Almeida, 2012	3 (16%)
Asia	Chaiklieng & Suggaravetsiri, 2012; Cheung et al., 2008; Vaz & Bharathi, 2004	3 (16%)
Europe	Pihl et al., 2002; Sandmark et al., 1999; Virtanen et al., 2007	3 (16%)
Africa	Ejere, 2010	1 (5%)
<i>Time of publication</i>		
1980 – 1989	Blair et al., 1984	1 (5%)
1990 – 1999	Jules & Kutnick, 1997; LaMaster et al., 1998; O'Loughlin et al., 1996; Sandmark et al., 1999	4 (21%)
2000 – 2009	Cardinal, 2001; Cheung et al., 2008; Pihl et al., 2002; Vaz & Bharathi, 2004; Virtanen et al., 2007	5(26%)
2010 – 2012	Brien et al., 2012; Brito et al., 2012; Carson et al., 2010; Chaiklieng & Suggaravetsiri, 2012; Costa & Silva, 2012; da Silva & Almeida, 2012; Ejere, 2010; Messing et al., 2011; Webber et al., 2012	9 (47%)

Most of the studies (n= 9 studies) were conducted in North America (USA and Canada), followed by South America (n= 3 studies), Asia (n= 3 studies), Europe (n= 3 studies), and Africa (n= 1 study), and most were published after 2000 (n= 14 studies). Studies

were classified into four groups for review: physical activity and environment; health; productivity; and role modelling. Questionnaires were most commonly used to gather information (n= 16 studies), followed by objective measures (n= 6 studies) including motion sensors, anthropometric, physical activity, and blood tests. Few articles reported the validity of the instruments used (Blair et al., 1984; Brito et al., 2012; Carson et al., 2010; Messing et al., 2011; Sandmark et al., 1999; Webber et al., 2012). A summary of the results of these studies that were included in the review is shown in Table 7.

Table 7: Summary of studies included in the review

Author	Sample	Purpose	Measures	Instruments	Context	Results
Blair et al., 1984	117 volunteer teachers (87 in the treatment school and 30 in the control school)	To determine the impact on health behaviours, satisfaction, and general well-being of educators	Physical fitness and health concepts Self concept and job satisfaction BMI <sup>b</sup> and body composition	7-day PA <sup>a</sup> recall treadmill, sit-and-reach test, cable tensiometer anthropometric questionnaire stress management scale	10-week intervention program, Aerobic Personalized Wellness Process. 50-minute class weekly before work, 55-minute supervised exercise session weekly, 5 evening seminars	Treatment school increases their fitness knowledge, exercise participation, treadmill time, and physical fitness, and decreases their body fat and weight At baseline, 7% of teachers reported vigorous exercise, post intervention 40% of teachers reported vigorous exercise and 8% of controls. All of the General Well-Being, Job satisfaction, and Self-Concept Scales, indicated an improvement in the treatment school. At treatment school, 44% overall lifestyle changed for better, 68% diet changed for better, 18% quitting smoking.
Brien et al., 2012	292 teachers from elementary (27.4%), high (72.2%), and vocational training (0.4%) schools in Canada	To test a self – determination model of teachers’ self – perception of performance	Psychological health at work Need Satisfaction Performance	Well-being manifestations measure scale, distress manifestation measure scale, basic psychological need at work scale, teachers’ Task performance questionnaire	School-based study, completing questionnaires	Competence need satisfaction had a statistically significant direct link to performance (p= 0.001) For total effects, the need for competence was related to both psychological health and performance, the need for relatedness was related to psychological health, and psychological health was related to performance.

Brito et al., 2012	1681 public school teachers from Sao Paulo Brazil.	To assess the PA in public school teachers	Physical activity, time spent in different activity intensities.	IPAQ, short version	Interview-administered questionnaire	Lower prevalence of low PA among teachers 55- 66 y compared with teachers 19-36 y ( $p < 0.05$ ) High PA was greater among men than women ( $p < 0.01$ )
Cardinal, 2001	551 teachers	To describe the PA and fitness promoting behaviours of HPERD <sup>c</sup> professionals, and their attitudes toward role modelling	Physical activity level BMI status Attitudes toward role modelling	Demographic questionnaire dichotomous question about PA behaviour, weekly leisure-time exercise questionnaire, BMI, attitude toward role modelling questionnaire.	Consultation to professionals associated to HPERD by mail questionnaires	61.5% female respondents 83% active, 17% inactive 6.8% underweight, 52.6% normal weight, 32.1% overweight, 8.5% obese The active respondents had more favourable attitudes toward role modelling compared to inactive respondents ( $p < 0.05$ ; $d = 0.59$ ) Underweight and normal weight had more favourable attitudes toward role modelling compared to overweight and obese participants ( $p < 0.05$ ; $d = 0.35$ )
Carson et al., 2010	189 child care teachers from 28 private licensed early care and education centres in the USA.	To test a model that permits the examination of the associations between PA behaviours across work & non work domains & adverse outcomes in early childcare teachers	Physical activity behaviour Emotional exhaustion Absenteeism Turnover intentions	Questionnaires: BHPAQ <sup>d</sup> and MBI-ES <sup>e</sup> One-item global rating	Cross-sectional study about PA as a buffer against experiences of emotional exhaustion, absenteeism, and turnover intentions	The work and leisure-time physical activity indices were correlated negatively with emotional exhaustion. Absenteeism correlated negatively with the work and leisure-time physical activity indices Workplace PA behaviour had a significant indirect effect on both teachers' migration and attrition intentions ( $-0.07$ ).

Chaiklieng & Suggaravetsiri, 2012	452 (primary and secondary) school teachers from 54 schools in Thatphanom, Thailand	To investigate the prevalence and risk factors of Repetitive Strain Injuries (RSIs)	Health status Work characteristics	Questionnaire Light meter Physical fitness test	Personal health behaviours and work characteristics at school.	WHR <sup>f</sup> : 31.4% obese BMI: 43% obese, 49% normal, 8% underweight Chronic diseases: asthma & diabetes 19%, high blood pressure 16% Regular exercise or more than twice a week 38% Most teachers had the physical function of muscle lower than standard recommended standing + sitting 79% of the teaching time. Teachers had complained of getting back pain from using computers (42%), and to stretch to write on boards (36%) 81% of teachers' office and classrooms had light intensity lower than the standard. Poor physical fitness was correlated with developing repetitive strain injury. Teachers 20-30 y have high levels of emotional exhaustion. 54% of teachers don't suffer any verbal abuse, while 46% said yes, from their students Teachers with more experience and age are less vulnerable to the onset of burnout 51% of teachers work between 40 – 60 h/week.
Costa & Silva, 2012	100 teachers from 5 <sup>th</sup> to 8 <sup>th</sup> grade and High School public schools of Umuarama, Brazil	Analyse the work environment factors that affect the quality of life of public school teachers	Relation between work environment and quality of life	Questionnaires: one demographic and school related. Another about burnout, Maslach Burnout Inventory	School environment	

da Silva & Almeida, 2012	120 teachers from municipal elementary schools of Sao Paulo, Brazil.	To describe the physical and postural aspects concerning the work of elementary school teachers	Frequency of postural change	Questionnaire	Daily life of teachers	<p>“No physical activity” as physically tired at work. 55% do not have regular physical activity.</p> <p>Postural aspect such as writing on the board, correction of homework, standing up for a long time were pointed as responsible for the job being physically tiring</p> <p>Physical discomfort occurred in the upper and lower limbs,</p> <p>Pain was the most prevalent complaint</p> <p>Standing up is the most frequent posture by teachers.</p>
Ejere, 2010	200 primary school teachers from 10 schools in Uyo, Nigeria	To explore the relationship between absenteeism and job satisfaction, meaningfulness of work, and job stress	Absenteeism job satisfaction perception of meaningfulness of work, job stress	Survey	In determining the negative impact on student academic achievement, repeated absence of teachers was assessed	<p>40% had low level of absenteeism.</p> <p>21% had high job satisfaction</p> <p>30% had high job value or worth</p> <p>25% perceived low job stress</p> <p>Strong positive relationship between absenteeism and job satisfaction.</p> <p>A relationship exists between absenteeism and the perception of meaningfulness of work</p> <p>A relationship exists between absenteeism and stress.</p>

Jules & Kutnick, 1997	1756 students, aged 8 to 16 years, in Trinidad and Tobago	To explore similarities and differences between boys and girls in their perceptions of a good teacher	Concepts and characteristics	Essays, Interviews	Examine differences in concepts from a society where girls achieve superior academic performance	<p>All of the children identified physical appearance and regular attendance as main physical and personal characteristics of a good teacher.</p> <p>In addition, educational background, dedication to the job and professional responsibilities are identified. Children expected care and kindness.</p> <p>Boys of all ages emphasized a desire for the teacher to demonstrate assertive control, and sensitivity to students' needs</p> <p>The good teachers encourage students learning through inclusive, participatory activities.</p>
LaMaster et al., 1998	18 fourth and fifth grade elementary school teachers from California, USA	Determine the relationship between PE <sup>g</sup> teachers HPA <sup>h</sup> to the way they conduct PE classes	Leisure-time physical activity Time spent in different intensities of physical activity	Self-report: Godin Leisure-time Exercise questionnaire, direct observation: SOFIT (System for Observing Fitness Instruction Time)	Physical education classes provided by classroom teachers	<p>68% of teachers' energy expenditure from PA occurred before or after school on weekdays.</p> <p>No significant relationships between teachers' habitual PA and the lesson context provided</p> <p>Significant correlation between teachers' habitual PA and how they behave during class time (<math>r=0.51</math>, <math>p&lt;0.014</math>).</p>

Messing et al., 2011	35 school teachers of grades 7 to 11 from Montreal, Canada	Characterise the teachers' workload. Identify working conditions that could be a source of difficulty and discouragement for teachers	Work activity, environmental parameters, working postures	Interview, direct observation, physical environment measurement by thermometer, sonometer and luxmeter.	School environment, staff room and classroom conditions	67% of the time spent in academic subject teaching, 9% in discipline, 34% in academic support, 20% in preparation and organisation, 10% in administrative tasks, and 16% adjusting the physical environment. 77% of the time was standing. Temperature, noise and lighting at the workplace were greater than the normal parameters.
O'Loughlin et al., 1996	260 elementary school teachers (125 intervention and 135 controls) from 16 schools in Montreal, Canada.	To evaluate the impact of school-based screening on smoking, leisure time exercise, and fat consumption of personnel working in schools offered CVD risk factors screening. Teachers' perception about their role in promoting heart health with students.	Cardiovascular risk factors	Questionnaires: -Sociodemographic and health condition -Fat consumption	Intervention by screening cardiovascular risk factors and counseling versus only screening	At baseline, 51% elevated cholesterol, 26% obese, 14% high blood pressure, 40% had 2 or more cardiovascular risk factors, 42% were advised to reduce fat consumption, and 46% were advised to increase PA. Post intervention, 62% increase PA versus 47% in the control group (p= 0.02). Teachers exposed to screening increased the frequency of discussions related to heart health with their students. Intervention teachers increased their role in heart health promotion at school (p= 0.04).



Cheung et al., 2008	52 volunteer primary school teachers from 4 schools in Hong Kong	To examine the effectiveness of a 6-week intervention that aimed to promote teachers' PA levels during working hours	Number of steps (to work – at work – off work) Stage of changes classification	Pedometer, questionnaire, anthropometric measures	Pilot study school-based 6-week intervention on teacher active behaviour changes using environmental stimuli	Stage of change classification baseline: action 25%, preparation 12.5%, inactive 62.5%; Post intervention 22% action, 39% preparation, 39% inactive. Post intervention steps at work increased in intervention group ( $p < 0.001$ ). 68% teacher reported spending over 11 h/d on school work Pedometer was most effective post intervention ( $3.29 \pm 1.39$ ) in a 1 to 5 scale for awareness and effectiveness. SMS and poster scored above 3.2 for awareness and 2.5 for effectiveness.
Pihl et al., 2002	188 full time male teachers (86 physical education teachers, and 102 teachers of other subjects) in Tartu, Estonia	To evaluate the importance of leisure-time PA on physical working capacity and some health risk factors in older PE teachers.	BMI - WHR Body composition Lipid profiles Physical working capacity Exercise heart rate	Questionnaires Anthropometric Bioelectrical impedance Blood test Cycle Ergometer test Sport tester Vantage NV	A case-control study, comparing PE teachers with their colleagues of other subjects	PE teachers had a moderate intensity PA, controls had low PA 59% of PE teachers considered themselves regularly physically active, controls were 12%. Energy expenditure among PE teachers 1370 kcal/week, controls 322 kcal/week. Physically active PETs had a significantly lower risk of all musculoskeletal disorder (OR 0.52; 0.29 – 0.94), lower risk of hypertension (OR 0.25; 0.13 – 0.47), lower risk of overweight (OR 0.63; 0.21 - 0.94).

Sandmark et al., 1999	30 volunteered physical education teachers (20 female and 10 male) in primary and secondary schools from Stockholm, Sweden.	To measure and quantify exposure to physical workload in PE teachers	Step, frequency of jumps, knee bends and lifting and carrying. Time sitting, walking, and other postures. Perceived exertion.	Pedometer (Fitty 3 Electronic) Handheld computer (PSION) Heat rate recorder (Sport tester PE 3000) Inclinometer Questionnaire Perceived exertion scale	Physical education classes	Sitting time 24 min/day (8%) Walking 5km/day 3 – 32 min/day in awkward positions (mean 6 min/day) 78% in upright position Heart rate: 95% female teachers over 100 bpm <sup>1</sup> on an average of 44% of the time; 70% male teachers over 100 bpm on an average of 25% The rating of perceived exertion was 13 “somewhat strenuous” for women, and was 12 “median” for men.
Vaz & Bharathi, 2004	198 (25 male and 173 females) school and college teachers in Bangalore, India	To assess the total and occupational PA status of school and college teachers.	Energy expenditure physical activity	Questionnaire	Daily life activities, including occupational, household, and discretionary exercise activities	Time spent at work 432 ± 73 min/day; sitting at work 184 ± 79 min/day; standing 170 ± 99 min/day; 67 ± 50 min/day walking; 11 ± 27 min/day in activities more strenuous than walking. PA: 12% sedentary, 44% mildly active, 13% moderately active, 21% moderately heavy physical active, 10% heavily active. 18% of the sample spent >60% of the time at work sitting. Occupational activity around 41% of the daily energy expenditure.

Virtanen et al., 2007	1862 teachers (1471 female and 391 male) from 216 public schools in Finland	To investigate the association of workplace neighbourhood socioeconomic status with health behaviours, health and working conditions among school teachers	Neighbourhood and social status relation Health indicator Working conditions	Questionnaire Official Government statistics	Part of a large research project on health of government personnel	Teachers working in schools in the poorest areas had a 2.3 fold risk of heavy alcohol use, 1.4 times greater risk of any chronic disease, 1.2 times greater risk of cardiovascular disease, 1.3 greater risk of musculoskeletal disease, and 1.5 times greater risk of mental disorders. Teachers working in the high socioeconomic areas reported higher participation in occupational training, higher teaching efficacy and lower mental workload.
Webber et al., 2012	745 female public elementary school personnel in Louisiana, USA	To reduce overweight and obesity among school employees by altering the school environment to increase healthy eating and PA	BMI and % of fat, blood pressure, lipid profiles and glycemia, PA	Anthropometry, blood test, accelerometry	A group randomised controlled trial	72% obese or overweight Lipid profile in normal values No one achieved 1 minute of MVPA <sup>j</sup> during the day 21 min/day of light intensity activities

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<sup>a</sup>PA = physical activity; <sup>b</sup>BMI = body mass index; <sup>c</sup>HPERD = Health, physical education, recreation, and dance; <sup>d</sup>BHPAQ = Baecke's Habitual Physical Activity Questionnaire; <sup>e</sup>MBI-ES = Maslach Burnout Inventory – Educators Survey; <sup>f</sup>WHR = waist to hip ratio; <sup>g</sup>PE = physical education; <sup>h</sup>HPA = Habitual physical activity  
<sup>i</sup>bpm = beats per min; <sup>j</sup>MVPA = moderate to vigorous physical activity

### *Teachers' occupational physical activity and work environment*

Physical education teachers' habitual physical activity mostly occurred before or after school on weekdays and accounted for approximately 70% of their energy expenditure on weekdays (LaMaster et al., 1998). The energy expenditure of physical education teachers' is greater as 90% of physical education class time is spent standing (Sandmark et al., 1999). Physical education teachers in Estonia were categorised as moderately active at work in comparison with teachers of other subjects (Pihl et al., 2002).

Teachers working in public schools in Brazil had physical activity levels that were described as low, which varied according to age, gender, and city area (Brito et al., 2012). Da Silva and colleagues (da Silva & Almeida, 2012), observed that a contributing factor to a decrease in teachers' physical activity was fatigue in the upper limbs resulting from writing on classroom whiteboards. Approximately 70% of the time, teachers were engaged in standing and walking, which may have contributed to the finding that 55% of teachers reported not engage regular leisure time physical activity (da Silva & Almeida, 2012). Primary school and college teachers from South India spent  $430 \pm 70$  min/day at work and for 40% of work time teachers were seated (Vaz & Bharathi, 2004) whereas teachers in Thailand spent 80% of their teaching time in sitting postures (Chaiklieng & Suggaravetsiri, 2012) and Canadian teachers' spent ~80% of classroom time standing (Messing et al., 2011). In a recent study conducted in a large population of North American teachers it was reported that the average time spent in light intensity activities was 22 min/d and time spent in moderate to vigorous activity was less than 1 min/d (Webber et al., 2012). In summary, the physical activity and sedentary behaviours of teachers were inconsistent between physical education

teachers and teachers of other subjects and by country, which may be a reflection of different cultures, socio-economic conditions and teaching styles.

### *Physical activity interventions*

In a study carried out in Hong Kong (Cheung et al., 2008), it was found that promotional stimuli increased teachers' physical activity at work. Following a six-week intervention where teachers received a pedometer, SMS messages, posters and information leaflets about exercise benefits, teachers workplace steps increased to 7,200 ( $p < 0.0001$ ) from 6,300 at baseline (Cheung et al., 2008). Based on the Trans Theoretical Model approach (Marcus et al., 1992), a change from inactive to active behaviour was reported post intervention for the teachers (Cheung et al., 2008). In an earlier study (Blair et al., 1984), after a 10-week health promotion programme that emphasized exercise, stress management, and nutrition, teachers lost weight, their blood pressure was lower, and their physical fitness, general well-being and ability to cope with job stress improved.

### *School environment*

The physical and the social environment at school affect teachers' physical activity behaviour negatively when work conditions are poor, and / or the number of students to be supervised is high, which subsequently contribute to a greater workload (Messing et al., 2011). Primary school teachers are involved in multiple work-related tasks teaching, supporting student learning, organising activities, and managing the classroom environment (Messing et al., 2011), which increase the feeling of lack of time to achieve curriculum goals. Difficulties in balancing work-related activities and family

time are another factor that contributes to teachers' tension and frustration at work (Messing et al., 2011). The stresses of the teaching environment is high, which can lead to emotional exhaustion among younger teachers (20-30 y) compared with more experienced teachers, which are less vulnerable to the onset of psychological exhaustion (Costa & Silva, 2012).

In Canadian classrooms often the temperature was hotter than recommended (21 -24<sup>0</sup> C), the noise level was higher than the World Health Organisation recommendations (35 dBA), and the lighting was sub-standard (Messing et al., 2011). The uncomfortable classroom environment affected children's concentration and the teachers' ability to teach (Messing et al., 2011). In summary, providing a physically comfortable environment for teaching and intervening to increase workplace physical activity may improve teacher's ability to cope with job-related stress.

### *Teachers' health*

The earliest study to investigate teacher's health reported that 25% of teachers had no indication of cardiovascular risk, 40% had two or more risk factors and the rates of obesity were 26%, smoking 18%, and hypertension 14% (O'Loughlin et al., 1996). More recent studies have reported that there was an increase in the prevalence of cardiovascular risk factors overweight 72% (Webber et al., 2012), obesity 43%, hypertension 16%, and asthma or diabetes diagnosed for 19% of teachers (Chaiklieng & Suggaravetsiri, 2012). The increased health-risk were associated with low amounts of daily physical activity for normal weight, overweight and obese teachers (light intensity; 24, 24, 21 min/d and moderate to vigorous intensity; 0.8, 0.7, 0.5 min/d

respectively) (Webber et al., 2012). The main reason teachers provided for not being involved in physical activity on school days was that they were very busy (Webber et al., 2012). Obese teachers had poor metabolic profiles high blood pressure, plasma glucose, and triglycerides, and low HDL cholesterol (Webber et al., 2012). Physical education teachers showed a statistically significant lower risk of musculoskeletal disorders (OR: 0.52; CI: 0.29 – 0.94), and lower risk of being overweight (OR: 0.63; CI: 0.21 – 0.94) compared with teachers of other subjects, suggesting benefits to health by being physically active (Pihl et al., 2002).

Teachers working in schools located in the poorest neighbourhoods were found to have greater risk of developing chronic disease (1.4 times), cardiovascular disease (1.2 times), musculoskeletal (1.3 times) and mental disorders (1.5 times) than teachers working at schools in higher socioeconomic neighbourhoods (Virtanen et al., 2007). There was also a 2.3 times greater prevalence of teachers being a smoker or heavy user of alcohol when working in schools from low rather than high socioeconomic neighbourhoods (Virtanen et al., 2007).

Teachers with lower muscle function had poor physical fitness ( $p = 0.045$ ), and if there was a history of trauma, and / or chronic disease the risk of developing repetitive strain injuries were two times greater (Chaiklieng & Suggaravetsiri, 2012). Wearing high heel shoes ( $> 2$  inches) (OR: 1.6; CI: 1.03 – 2.51;  $p = 0.037$ ) and stretching to write on the whiteboard (OR: 1.7; CI: 1.06 – 1.60;  $p = 0.028$ ) was found to be associated with the development of repetitive strain injuries (Chaiklieng & Suggaravetsiri, 2012).

In summary, the most recent research indicates that teachers' habitual physical activity is low and obesity rates are high, which may increase the cardiovascular risk of this occupational group (Webber et al., 2012). Teachers are susceptible to exhaustion and stress (Costa & Silva, 2012), and those working in schools from low socio-economical areas may have greater health-risk than teachers working in high socio-economic schools (Virtanen et al., 2007).

### *Productivity*

Many factors affect work productivity including environment, salary, workload, absenteeism, motivation, and job satisfaction (Harvey, 1978; Milkman, 1997). Teachers assess their productivity in terms of their ability to; encourage student learning, to relate well with parents and students, to receive positive recognition from peers and supervisors and to perform normal teaching tasks successfully (Brien et al., 2012). Teachers productivity are generally scored with self-reported absenteeism in hours lost over the school week and presenteeism using a 10-point Likert scale, which is a self-assessed measure of job performance where 1 = worst and 10 = top performance (Kessler et al., 2007). Canadian teachers needed to experience job satisfaction in order to increase the quality of education they provided to students, which was dependent on a positive state of psychological health ( $p < 0.001$ ) (Brien et al., 2012). Autonomy was not related to teachers' work performance ( $p = 0.42$ ) but better psychological health allowed teachers to concentrate on their teaching-related tasks rather than on negative psychological states (such as depression), thereby improving their productivity at school (Brien et al., 2012).



The socioeconomic status of the neighbourhood where the school is located may affect teachers' work performance that was related to health status, which was negatively affected when teachers were employed in schools located in poor neighbourhoods (Virtanen et al., 2007). A study of 200 primary school teachers in Uyo, Nigeria, explored the relationship between absenteeism and job satisfaction (the meaningfulness of a job) and job stress (Ejere, 2010). Teachers that were regularly absent reported low job satisfaction (79%), perceived that their job was stressful (75%) and only 30% thought that their work was very meaningful (Ejere, 2010). Absenteeism is indicative of employee dissatisfaction, due mainly to poor working conditions, low job satisfaction and few career prospects (Ejere, 2010). General well-being, job satisfaction, and self-concept were improved during a 10-week physical activity and counselling intervention, suggesting that physical activity can modify psychological health (Blair et al., 1984). Preschool teachers absenteeism correlated negatively with their work and leisure-time physical activity, whereas regular physical activity, such as a walk during or after school is a key strategy for alleviating occupational stress (Carson et al., 2010).

In summary, a range of factors affects teachers' productivity including personal and professional competency, the socioeconomic status of the school neighbourhood, absenteeism, and perceived occupational stress. Increasing teachers' leisure-time and workplace physical activity can improve psychological health (Blair et al., 1984; Carson et al., 2010), which may increase teachers productivity and student learning (Brien et al., 2012).

### *Teachers as role models*

In a study of primary school student's perceptions of a good teacher, physical appearance and regular attendance emerged as the main characteristics of a good teacher, followed by educational background, dedication, and acceptance of professional responsibilities (Jules & Kutnick, 1997). All the students surveyed expected care and kindness, similar to parental nurturing of younger children, and security, educational support, trust and non-discrimination from the teacher (Jules & Kutnick, 1997). Female students expected the teacher to maintain good interpersonal relationships and use classroom-teaching strategies that facilitate student participation (Jules & Kutnick, 1997). Male students expected that the teacher should be more assertive and maintain control over student behaviour (Jules & Kutnick, 1997).

Teachers that were physically active, promoted physical fitness, and limited their general instructions and management of students were more likely to have students involved in moderate-vigorous physical activity (Martin & Kulinna, 2005), illustrating that role modelling is important for developing student's active behaviours. The New Zealand school curriculum recognises that physical activity plays an important part in children's learning processes (Ministry of Education, 2007). Teachers in the United States that were normal weight and physically active had more favourable attitudes toward role modelling active behaviours to their students ( $p < 0.05$ ;  $d = 0.59$ ) than overweight and obese teachers ( $p < 0.05$ ;  $d = 0.35$ ) (Cardinal, 2001). When teachers assumed responsibility to increase their habitual physical activity during school-based interventions, these teachers were more likely to discuss heart health with their students (Cheung et al., 2008; O'Loughlin et al., 1996). Teachers recognised the value of being a role model of physical activity for students and were in the preparation stage of the

Trans Theoretical Model, but few teachers were willing to adopt the active behaviour model (Cheung et al., 2008).

In summary, teachers are generally willing to be active role models (Cardinal, 2001) and when teachers engage in an active lifestyle and model this for students, they provide a better learning environment.

### **3.4. Limitations**

There were several limitations in this review including the search strategy, which may not have identified all of the studies. In general, data were obtained from teachers working in urban schools, which may not reflect the experiences of teachers from rural settings. The inclusion criteria excluded studies that did not classify the workplace physical activity of teachers.

### **3.5. Conclusions**

Teachers that have a positive state of psychological health are able to provide quality education for their students. Factors that influence teachers' psychological health include the ability to accrue sufficient workplace and leisure-time physical activity, a comfortable teaching environment, and job satisfaction. Teachers' productivity, job satisfaction, habitual physical activity, weight status, metabolic and psychological health are interdependent, and when all these variable are positive this allows teachers to better cope with job-related stress and achieve curriculum goals. Physically active teachers in the workplace provide a good role model for students' physical activity,

which is beneficial to student learning. Future studies need to determine the hierarchy of factors that are critical for teachers' psychological health that are beneficial to their productivity and thereby encourage student learning and physical activity.

### **3.6. Future directions**

From the studies included in this review, the variability in the magnitude of teachers' workplace physical activity and sedentary behaviour and the relationship with teachers' productivity and health are unclear. Teachers from different countries spent different proportions of time sitting, standing and walking in the classroom and more research is required to understand which teaching style is beneficial to teachers' health and student physical activity.

The following Chapters (4-6) consist of the methods, results and discussion of three studies that provide an in-depth analysis of the teachers' work-related sedentary and physical activity behaviours and the effect on teachers' cardiovascular health and their students' school-based physical activity. Chapter 4 details all methodological aspects of Studies 1-3. Chapters 5 and 6 of the thesis are devoted to reporting the results of Studies 1-3, and discussion of the findings presented as recommendations and conclusions.

## CHAPTER 4: Methods

In this doctoral research, a mixed method approach was adopted. A mixed method approach highlights the strengths and minimises the weaknesses of solely qualitative and solely quantitative approaches (Johnson & Onwuegbuzie, 2004) making it an appropriate method when studying human behaviour. Recent investigation into physical activity and sedentary behaviour is carried out based on this multidisciplinary approach, which groups different perspectives together and is considered optimal for understanding aspects of human behaviour (Babakus & Thompson, 2012; Brownson, Brennan, Evenson, & Leviton, 2012; Davey, Hurst, Smith, Grogan, & Kurth, 2011; Poobalan, Aucott, Clarke, & Smith, 2012; Quarmby, Dagkas, & Bridge, 2011; Ribera, McKenna, & Riddoch, 2005; Willenberg et al., 2010; Withall, Jago, & Fox, 2011). The quantitative approach was used to collect data on teachers' physical activity, sedentary behaviour and health status, and analyses were conducted to determine whether there were any effects of teachers' physical activity and sedentary behaviour on their students' physical activity behaviours. The qualitative approach was used to understand the school environment in terms of policy, plans and strategies as well as teachers' perceptions of their physical activity and sedentary behaviour.

In compliance with the key principles from Auckland University of Technology Ethics Committee (AUTECH), respect, confidentiality and privacy of participants' information were assured. The ethical approval for this study was granted by the AUTECH on November 2, 30 2010 (Appendix 1).

#### **4.1. Participants**

Teachers and their students from primary schools across the Auckland Metropolitan Area were invited to participate in the three studies of this thesis. Only public schools were invited to participate because they utilised standard educational programmes and followed the New Zealand National Curriculum.

#### **4.2. Study 1: Identifying barriers and facilitators of teachers' physical activity at school.**

##### *Sample size*

Qualitative research is not useful for making inferences from large population samples, therefore participants were recruited according to predetermined characteristics (Thomas et al., 2005). A non-probabilistic purposeful criterion sample (Pitney & Parker, 2009) was used to select eight teachers and / or principals from schools across the Auckland Metropolitan Area to participate in face to face interview. Four high decile schools and four low decile schools were selected (*Deciles classification: Highest, deciles 6 to 10; lowest, deciles 1 to 5*). The Ministry of Education in New Zealand uses the decile classification system to allocate funding to schools. *Decile 1 schools include the highest proportion of children from low socioeconomic backgrounds. Schools in decile 10 include the highest proportion of students from high socioeconomic backgrounds* (Education Review Office, 2013).

The main inclusion criterion for schools was that they did not participate in health promotion programmes, and that recruited teachers had more than three years of teaching experience.

### *Recruitment*

Eight teachers and six principals, from different areas of Auckland City (to ensure a range of diversity of experiences and perspectives), were invited to be interviewed. Ten accepted (6 and 4 respectively). Due to data saturation after eight interviews, only four principals' and four teachers' interviews were considered in the final analysis, and the recruitment process was stopped. The interview data from one of the teachers was used as a pilot to refine the questions so data from that interview was excluded from the analysis as was an additional interview that did not have a full transcript owing to a recording system error.

### *Data collection*

The candidate according to an individual arrangement with participants carried out the interviews during the week following physical activity and sedentary behaviour measurements. The setting for the interview was agreed with participants to protect their privacy, to ensure that the interview was conducted in a familiar and comfortable place and to avoid the need for the participants to travel. Generally, the interviews with the teachers took place in the school staff room, and for the principals in their offices. The interviews length was 20 to 60 minutes in duration, and were recorded and transcribed for later analysis. The interviews followed a semi-structured format, with

key questions and complementary questions asked when necessary to clarify or glean information that is more detailed.

### *Measurements and instruments*

Interview questions in Appendix 5 were formulated to guide the conversation. General questions were asked first so that the interviewee could provide details of the usual workplace activities at school, school routines and internal organisational culture. Next, the discussion was focused on an evaluation of the context in terms of variables of analysis (physical activity and sedentary behaviour), and identifying barriers and facilitators of workplace physical activity. Finally, the last questions focused on the teachers' suggestions of school-based facilitators of physical activity and practical approaches to integrate additional physical activity into teachers and their students' school routine.

### *Analysis*

All interviews were transcribed and then analysed using a thematic analysis approach identified by Braun and Clarke (Braun & Clarke, 2006):

- First, the investigator should read and re-read the transcripts to gain familiarity with the data, and make notes or thoughts during the reading.
- Transcript data should be coded in a systematic process across the entire dataset. Investigators are encouraged to list interesting features of the transcript text.
- Investigators should allocate similar data by codes and then identify themes from the codes.



- From the identified themes, investigators should define and name the themes to explore the essence of each theme.
- Finally, the data set should be compiled with reference to the themes, and when the final analysis is completed, the findings should be organised into a written report.

To ensure rigor a systematic method was used:

- A professional transcriber transcribed the voice recordings of the teachers.
- To ensure that the written account was word for word correct with the voice recording, the researcher checked the voice recordings against the written transcripts.
- Student (MC) and supervisor (EH) then coded the themes independently.
- Codes were compared and any differences were discussed until an agreement was reached.
- Where there was a difference MC and EH would re-read the transcript and decide on an appropriate code.
- Once agreement was reached on the coding, codes were organised into three themes.

### **4.3. Study 2: Teachers' physical and sedentary activity patterns at work, cardiovascular risk and productivity.**

#### *Sample size*

Sample size was determined a-priori using daily step count as the main outcome measure. Step count is widely reported in the physical activity literature (Bravata et al., 2007; Chen, Acra, Donahue, Sun, & Buchowski, 2004; Mutrie et al., 2002; Okamoto et al., 2010; Tudor-Locke & Bassett, 2004; Tudor-Locke, Williams, Reis, & Pluto, 2002; Williams, Matthews, Rutt, Napolitano, & Marcus, 2008) and is often the dependant variable reported in studies measuring physical activity in the workplace (Chan et al., 2004; Dishman et al., 2009; Eves & Webb, 2006; Faghri et al., 2008; Gilson, 2008; Levine & Miller, 2007; Miller & Brown, 2004; Puig-Ribera, McKenna, Gilson, & Brown, 2008; Schofield et al., 2005; Shaw, Alfonso, Howat, & Corben, 2007; Thompson, Foster, Eide, & Levine, 2008; Tudor-Locke, Burton, et al., 2009). This study used a sample size estimation spreadsheet (Hopkins, 2006) to arrive at a sample size for statistical significance. The smallest worthwhile difference of 1,000 pedometer steps and a between-subject standard deviation of 1,700 pedometer steps was reported in a previous study by Steele & Mummery (Steele & Mummery, 2003) and from the maximum rates of statistical error (Type I: 5% and Type II: 20%), the estimated sample size of 93 participants was determined (see Appendix 6 for details). To allow for a dropout rate of 10% due to unforeseen circumstances, it was decided to recruit an additional 9 subjects increasing the required sample size to 102.

### *Recruitment*

To meet the sample size requirements for adequate statistical significance, teachers from 167 schools (68%) were contacted to take part in this study (there are currently 246 primary schools in Auckland City). A stratified random selection process selected 42 schools and each was contacted by email, with only one positive reply. In order to recruit the required sample size, Auckland was divided into four geographical regions and school principals from each region were visited in person to explain the study in detail.

Schools from each region were recruited into the study to form a convenient sample of teachers shown in Table 8. Twenty-one schools agreed to participate, 54 declined and 92 never responded, despite being contacted at least three times after the initial visit. The main reasons Principals provided for declining were high workload at school and previous commitments, and some schools were already participating in other research (sometimes more than one project).

**Table 8: Number of schools contacted and their responses**

	Total	Central	North	West	South
Contacted	167	54	25	40	48
Accepted	21	12	5	2	2
Declined	54	14	10	15	15
No answer	92	28	10	23	31

After schools agreed to participate, an invitation was extended to teachers, the principals, and deputy principals. The invitation to take part in the study was accepted by 103 teachers from high and low decile schools shown in Table 9, whom provided informed consent at explanatory meetings where the study details and data collection-

processes were described. Copies of consent and assent forms are presented in Appendix 2.

**Table 9: Number of teachers participating**

	Total	Higher deciles	Lower deciles
Teachers	103	71 (69%)	32 (31%)
Male	12 (11.7%)	8	4
Female	91 (88.3%)	63	28

### *Data collection*

Data collection was carried out February to November 2011 during school terms, with a scheduled time of two weeks for measurement at each school. During the first week, teachers' anthropometric and blood parameters were measured, and in the second week, physical activity and sedentary behaviour were monitored. Physical activity and sedentary behaviour were measured over 24 hours for five consecutive days during the school week, from Monday morning (before the start of the school day) to Friday afternoon (after the end of the school day), using two types of accelerometer (ActiCal<sup>TM</sup> and activPAL<sup>TM</sup>). Only data collected Tuesday, Wednesday, and Thursday were included in the analysis, to ensure that 24 hours of data were collected (excluding logged monitor not worn time). Each participant received the devices on Monday morning and the accelerometers were worn throughout the school week. Participants were asked to wear the devices at all times including sleep, except when bathing or swimming to increase compliance. Teachers completed a log sheet to record sleeping times, school arrival and departure times, times the devices were not worn, and times spent in unusual activities that were school or work-related (e.g., school trip, sports day) (see Appendix 3).

Teachers completed two questionnaires, the Questionnaire of Habitual Physical Activity to determine perceived habitual physical activity and the Health and Work Performance Questionnaire to determine productivity. Copies of questionnaires are shown in Appendix 4.

### *Measurements and instruments*

#### **Anthropometric measurements**

Trained researchers measured anthropometric data of participants using the International Society for the Advancement of Kinanthropometry (ISAK, 2001) protocols.

#### *Weight*

Weight was measured in fasting conditions, barefoot, and with as little clothing as possible, using a digital scale (Model Seca 770, Seca, Hamburg, Germany). Participants stood on the centre of the scales without support and with the weight distributed evenly on both feet.

#### *Height*

Height was measured using a portable stadiometer (Design No. 1013522, Surgical and Medical Products, Seven Hills, Australia). The participant stood with feet and heels together and the buttocks and upper part of the back touching the scale. The head was placed in the Frankfort plane and did not touch the scale. The researcher placed his hands far enough along the line of the jaw of the participant to ensure that upward

pressure was transferred through the mastoid process. The participant was instructed to take and deep breath and hold while keeping the head in the Frankfort plane. A measurement was taken at the end of the deep inward breath.

### *Waist*

This girth is taken at the level of the narrowest point between the lower costal (10th rib) border and the iliac crest. The researcher stood in front of the participant who abducted the arms slightly to allow the tape to be passed around the abdomen. The stub of the tape and the housing were then both held in the right hand while the researcher used the left hand to adjust the level of the tape at the back to the adjudged level of the narrowest point. The researcher resumed control of the stub with the left hand and using the cross-hand technique positioned the tape in front at the target level. The participant was instructed to lower their arms to the relaxed position. The tape was then readjusted as necessary to ensure it had not slipped and did not excessively indent the skin. The participant breathed normally and the measurement was taken at the end of a normal expiration (end tidal). If there was no obvious narrowing the measurement was taken at the mid-point between the lower costal (10th rib) border and the iliac crest.

### *Hip circumference*

This girth was taken at the level of the greatest posterior protuberance of the buttocks, which usually corresponded inferiorly to about the level of the symphysis pubis. The researcher passed the tape around the hips from the side. The stub of the tape and the housing were then both held in the right hand while the researcher used the left hand to adjust the level of the tape at the back to the adjudged level of the greatest posterior

protuberance of the buttocks. The researcher resumed control of the stub with the left hand, and using the cross-hand technique, positioned the tape in front and the sides so that the tape was held in a horizontal plane at the target level. The tape was then readjusted as necessary to ensure it had not slipped and did not excessively indent the skin.

Three measurements were made and recorded and the mean was used to calculate Body Mass Index (body weight in kg divided by the height<sup>2</sup> in cm) and Waist-to-Hip Ratio (waist measurement divided by the hip measurement shown as a ratio).

### **Blood parameters**

In order to determine participants' health status, several blood parameters were measured in fasting conditions before the start of work at school.

#### *Blood pressure*

Blood pressure was measured twice with participants sitting in a relaxed position with the cuff on the right arm at the level of the heart. The manometer was placed above the elbow and a stethoscope was used to find the brachial pulse. The cuff was inflated to the peak inflation level and then deflated at rate of 2 mmHg per second. The first sound after inflating the cuff was recorded as the systolic blood pressure and the last sound was recorded as the diastolic blood pressure (Pickering et al., 2005). Portable mercury ALP K2 Sphygmomanometer (Japan) was used for the measurement.

### *Blood glucose*

The glucose level was assessed using the Accu-Check Performa (Roche Diagnostic GmbH, Germany). Using a lancing device to pierce the skin of the index finger, a hanging drop of blood was obtained from the participants' finger to apply immediately test strip inserted in the meter. The result appeared on the screen after a few seconds. According to Karon (Karon et al., 2007), the Accu- Chek has very good validity ( $r = 0.92$ ).

### *Total cholesterol*

The Accutrend Plus (Roche Diagnostic GmbH, Germany) was used to assess the total cholesterol. The blood sample for analysis was obtained using the same method as described for the blood glucose assessment. The result appeared on the meter screen after 180 seconds. According to Moses (Moses, Calvert, & Storlien, 1996), the Accutrend Plus<sup>TM</sup> has a very good validity ( $r = 0.935$ ).

### *Triglycerides*

Triglycerides concentration in the blood stream was assessed by the Accutrend Plus (Roche Diagnostic GmbH, Germany), using the same procedure described above. The result appeared on the screen after 120 seconds. The Accutrend Plus<sup>TM</sup> validity ( $r = 0.972$ ) was reported by Luley (Luley et al., 2000).



### *Cardiovascular risk*

Cardiovascular risk (CVR) was assessed by the Framingham formula (Anderson, Odell, Wilson, & Kannel, 1991) and the adjustments as suggested by the Joint British Societies' paper (Society et al., 2005) and the Cardiovascular Risk Assessor, from blood pressure measurement, glucose level, total cholesterol and triglycerides concentration in the blood stream. HDL-cholesterol was not measured and the standard value of 1.0 mmol/L was inserted to the equation.

### **Physical activity and sedentary behaviour measurement**

#### *Accelerometry*

The time spent in sedentary, light, moderate and vigorous activities was measured by ActiCal™ accelerometer (Mini-Mitter, Sunriver, OR). The ActiCal™ was attached to participants' waists with an elastic band, and teachers were asked to wear them 24 hours per day. Energy expenditure was estimated for teachers only.

ActiCal™ accelerometers are electronic devices that measure accelerations produced by body movement. They use piezoelectric transducers and microprocessors that convert recorded accelerations to a quantifiable digital signal referred to as 'counts' (Sirard & Pate, 2001). The reported validity for ActiCal™ accelerometer is high ( $r = 0.73$ ) (Esliger et al., 2007).

Actical accelerometer data were exported from the manufacturer spreadsheets using 15 second epochs, which define activity into sedentary, light, moderate and vigorous

intensities using regression equations from a calibration study performed by Heil (Heil, 2006).

- Accelerometers were delivered on Monday morning before school and picked up on Friday after school was finished.
- Participants were instructed to wear the monitors at all times including sleep but to remove the devices when bathing or swimming.
- Logs were kept of times the monitor was removed for bathing or swimming and the accuracy of the logs was checked against the accelerometer data.
- The average time the accelerometer was removed for bathing was 20 minutes.
- A valid day was 24 hours of data collected less any logged times when the accelerometer was removed to be sure of the actual time spent in sedentary activity.
- Participants had to have 3 days of continuous data to be included in the study.
- Only 4 teachers and 11 students data were removed from the study for non-compliance or because the non-wear time logs and accelerometer data were not matched.
- The compliance rate for teachers was 96% and 92% for students.
- A day was analysed as waking hours only and time spent in moderate to vigorous activity was minutes per day. Hours per day was used in the tables so that the same unit of time was used for sedentary and other activity intensities.

The time spent in sitting/lying and standing positions, was measured by activPAL™ accelerometer (PAL Technologies Ltd, Glasgow, UK), worn on the front of the thigh attached with a hypoallergenic strap. The number of transitions from sitting to standing and vice versa, the steps count and time spent stepping were recorded by the activPAL™. The activPAL™ professional is a small electronic device designed to quantify free-living daily activities. The device contains a microprocessor, sensing element, recording element, associated electronics and power supply. The microprocessor controls the processing and recording of the sensor signal and the communication with a host PC. The activPAL™ is highly correlated ( $r = 0.99$ ) with direct observation (video recording) in children (Aminian & Hinckson, 2012), and in adults ( $r = 0.99$ ) (Ryan, Grant, Tigbe, & Granat, 2006).

For the activPAL™ was used the same procedure, the sedentary cut-point was 100 counts and steps, sitting time and transitions from sitting to standing data in were used into the analysis

### *Questionnaire*

There are several methods to assess habitual physical activity using standardised questionnaires in different contexts (Paffenbarger, Blair, Lee, & Hyde, 1993). In the present thesis, teachers' habitual physical activity was determined using the QHPA (Questionnaire of Habitual Physical Activity) or Baecke questionnaire (Baecke, Burema, & Frijters, 1982). The QHPA in paper form was given to the participants at the same time as the steps and collected back at the end of the physical activity and sedentary behaviour measurement week.

This questionnaire considers in total 16 questions (see Appendix 4), eight for occupational physical activity, four related to sport leisure activities, and four related to non-sport leisure activities and locomotion. The total score is obtained by adding the individual score of each dimension (work + sport + leisure). Once the total score is obtained, it is classified into three categories: low, moderate, and high index (Table 10).

Baecke et al. (Baecke et al., 1982) reported a high level of test-retest reliability (0.80 work index, 0.90 sport index, 0.74 leisure-time index).

Table 10: QHPA Score Index

Score Index	Low	Moderate	High
Work activity	1.5 – 2.4	2.5 – 3.4	3.5 – 4.5
Sport activity	0.8 – 2.3	2.4 – 3.7	3.8 – 5.0
Leisure time activity	0.3 – 1.8	1.9 – 3.4	3.5 – 5.0
Total	2.5 – 6.5	6.6 – 10.5	10.6 – 14.5

### Productivity measurement

The Health and Work Performance Questionnaire (HPQ) (Kessler et al., 2003) was used in this study to determine the teachers' work performance. Traditionally, three outcomes are studied regarding work productivity: absenteeism, work performance, and job-related accidents. The HPQ questionnaire was designed to determine the work productivity in a wide number of jobs assessing these three aspects (Kessler et al., 2003).

The Health and Work Performance Questionnaire is a short self-report instrument (which takes no more than 15 minutes to complete) that filters the occurrence of the most common health problems and their treatment. The Health and Work Performance Questionnaire is capable of gathering a large amount of data and seems an appropriate tool to use in a work health and productivity survey.

### Absenteeism

In the Health and Work Performance Questionnaire, absenteeism is assessed according to the number of hours missed on sickness absence days, the number of hours missed on workdays, extra hours of work, differentiating between sickness absence and other types of absences. To quantify the absolute absenteeism, actual worked hours in the past seven days were subtracted from the expected worked hours by the employer in the same period. Relative absenteeism was calculated by dividing the absolute absenteeism score by the expected hours of work (Kessler et al., 2007)

### Presenteeism

The Health and Work Performance Questionnaire assesses work performance (or presenteeism) using a simple self-report global rating scale, and the participants are asked to rate their work performance from 0 to 10, where 0 is considered as the worst performance and 10 the best. Before the participants rate their work performance, a series of four questions are asked in order to get an understanding of critical aspects. These questions focus on the quantity of work, quality of work, interpersonal aspects of work, special work successes, special

work failures and accidents-injuries. A second set of five questions is focused on determining the participants' work performance, based on a separate rating of their own usual performance, and comparing their own performance with other workers in the same job. To measure absolute work performance, participants reported their own performance over the past seven days, as described above, which was converted into percentages. Relative work performance was calculated dividing the actual performance by the performance of most workers in the same position, ranging from 0.25 to 2.00 (Kessler et al., 2007).

#### Job-related accidents

Job-related accidents in the Health and Work Performance Questionnaire were assessed by a single open-ended question. This question sought information about incidents that led to breakage or other loss of property, delays in production or other decreases in work performance, physical injury, and serious risk of loss, delay, or injury. After that, the information is contrasted with the company to obtain the monetary cost of the accident.

Originally, the Health and Work Performance Questionnaire was designed to estimate the cost of health problems at the workplace in terms of reduction in work performance, absenteeism due to illness and work related injuries. The clinical version has questions relating to the past seven days in these three aspects. It is a short instrument, which takes no more than 10 minutes to complete.

Absenteeism was measured as hours missing from work, focusing on total hours missed for all causes (sickness, holidays, other) not just illness. Information about the incidents of absenteeism was collected by open questions that report the number and nature of these incidents. The Health and Work Performance Questionnaire presents a significant association ( $r= 0.61$  to  $0.87$ ) of work hours assessments with payroll records (Kessler et al., 2003), and work performance assessments with supervisor rating ( $r= 0.52$ ) (Kessler et al., 2003).

Only were analysed data for the absenteeism and presenteeism questions, we should have removed the additional questions as Kessler suggested in 2007 (Kessler et al., 2007).

### **Benchmarks**

To determine the nutritional status (BMI) of the participants the WHO classification was used (Daniel, Marion, Sheps, Hertzman, & Gamble, 1999).

Table 11: The international classification of adult underweight, overweight and obesity according to BMI

Classification	BMI(kg/m <sup>2</sup> )	
	Principal cut-off points	Additional cut-off points
Underweight	<18.50	<18.50
Severethinness	<16.00	<16.00
Moderatethinness	16.00 - 16.99	16.00 - 16.99
Mildthinness	17.00 - 18.49	17.00 - 18.49
Normal range	18.50 - 24.99	18.50 - 22.99 23.00 - 24.99
Overweight	≥25.00	≥25.00
Pre-obese	25.00 - 29.99	25.00 - 27.49 27.50 - 29.99
Obese	≥30.00	≥30.00
Obese class I	30.00 - 34.99	30.00 - 32.49 32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49 37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004.

Cardiovascular risk was assessed using the Health Canada Waist-to-Hip Ratio (WHR), the Health Canada classification was used (Daniel et al., 1999).

Table 12: Aged and sex-specific cut-off points for classification of high compared with low waist-to-hip ratios

Age (y)	Waist-to-hip ratio	
	Men	Women
18–34	0.89	0.79
35–49	0.95	0.82
50–64	0.98	0.84
≥65	0.99	0.86

Based on age- and sex-specific norms from the Canada Fitness Survey.

The American Heart Association (AHA) categorisation was used as the reference for blood pressure (National Heart, 2002).



Table 13: Blood pressure categories defined by the AHA

Blood pressure category	Systolic mm Hg (upper #)		Diastolic mm Hg (lower #)
Normal	Less than 120	and	Less than 80
Pre hypertension	120 – 139	or	80 – 89
High blood pressure (Hypertension) Stage 1	140 – 159	or	90 – 99
High Blood Pressure (Hypertension) Stage 2	160 or higher	or	100 or higher
<u>Hypertensive crisis</u> (Emergency care needed)	Higher than 180	or	Higher than 110

For blood pressure cut point, the National Heart, Lung and Blood Institute (US) was used (Chobanian et al., 2003).

Table 14: Classification of blood pressure for adults (NHLBI, USA)

Blood pressure Classification	Systolic mmHg	Diastolic mmHg
Normal	<120	and <80
Pre hypertension	120–139	or 80–89
Stage 1 Hypertension	140–159	or 90–99
Stage 2 Hypertension	≥160	or ≥100

Total cholesterol and triglycerides cut point were based on the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel (National Heart, 2002).

Table 15: Classification of serum triglycerides and total cholesterol

	Triglycerides mmol/L	Total cholesterol mmol/L
Acceptable/optimal	0.45 - 1.69	< 5.17
Borderline high	1.69 - 2.26	5.18 - 6.18
High	2.26 - 5.65	≥ 6.19
Very high	≥ 5.65	*

*Adapted from the NCEP Expert Panel (2002)*

Estimated 10-year risk of cardiovascular disease (CVD) was calculated using the Joint British Societies' guidelines (Society et al., 2005), using the following measurements: blood pressure (systolic and diastolic), plasma glucose, triglycerides and total cholesterol, and integrating this information into the Cardiovascular Risk Assessor (Prais, 2006). Those with 10-year risk CVD  $\geq 20\%$  are considered high risk (D'Agostino et al., 2008). The formula used to determine cardiovascular risk required total cholesterol and HDL cholesterol concentrations, and the software automatically entered a value of 1 mmol/L if no value was entered for HDL cholesterol.

Table 16: CV risk classification

CV risk classification	%
Low	< 5 %
Light	5 – 9 %
Moderate	10 – 19 %
High	20 – 39 %
Very High	> 39 %

*Source: (Escobar & Obrequé)*

### *Statistical analysis*

All statistical analysis was carried out using SPSS for Windows (v. 18.0). Data are shown as mean  $\pm$  SD for all health parameters, physical activity and sedentary behaviour data, unless otherwise specified.

The physical activity and sedentary behaviour data statistical analysis was carried out using data from three full days of collection, discarding the first and the last days of the data series. Only participants with complete data were included for the analysis (A

maximum of one hour of missing data was acceptable). Include criteria to determine valid day of data, and why bouts were not considered.

Student t-test was carried out to determine differences on the means when quantitative variables were compared, with  $\alpha=0.05$  and 95% of CI.

To calculate the effect size of each correlation and to determine the clinical interpretation of the data, the Hopkins' "combining means and other t-distributed or normally distributed statistics" spreadsheet was used (Hopkins, Marshall, Batterham, & Hanin, 2009).

The odds ratio was calculated to determine the risk level of exposure to physical activity and sedentary behaviour on teachers' cardiovascular risk factors. The median of each variable was used as the threshold to calculate the odds ratio. The odds are the ratio of the probability that the event of interest occurs to the probability that it does not (Bland, 2000).

#### **4.4. Study 3: Comparison of teachers' and their students' physical and sedentary activity patterns.**

##### *Sample size*

Considering a classroom as a unit with a roll average of 20 children, 10% of the class rolls, two children per class from year 1 to year 6, were asked to participate. The

children were from the classes of the teachers participating in Study 2. The minimum sample size of 123 children was based on detecting a statistically significant correlation of 0.25 between sedentary behaviours (sitting time) of teachers and children, with a power of 0.80 at significance level of  $p = 0.05$  (Hopkins et al., 2009). Assuming a 15% drop out (children are more variable than adults, thus it was expected that the dropout rate would be higher) 140 children were selected to ensure 123 participants remained in the study.

### *Recruitment*

At the meeting with teachers in Study 2, one to four children from their classes were asked to participate in the research. The inclusion criteria for children was that they were responsible enough, as assessed by the teacher, to ensure that they could complete the requirements of the study. Teachers were asked to select only children who attended school regularly. An information sheet and consent and assent forms were then sent to parents to consider and sign and return if they were interested in their children being part of the study. The first four children to return signed consent and assent forms were selected to take part in the study. In total, 131 children participated in the research. Copies of consent and assent forms are presented in Appendix 2.

Table 17: Number of children participating

	Total	Highest deciles	Lowest deciles
Children	131	84 (64%)	47 (36%)
Male	61 (46.6%)	41	20
Female	70 (53.4%)	43	27

### *Data collection*

Children's data were collected at the same time as the teachers' data in Study 2, during the 2011 school year.

Physical activity and sedentary behaviour were measured over five consecutive days during the whole day, from Monday morning (from start of the school day) to Friday afternoon (at end of the school day). Only data collected in the middle days (Tuesday, Wednesday and Thursday) were considered in the analysis to ensure that complete days of data were collected.

Each child received the accelerometers on Monday morning and wore them throughout the school week, 24 hours per day. Participants were also asked to complete a log sheet which recorded all related relevant information, such as the time and activity performed when they were not wearing the devices, time spent in unusual activities, wake up time and bed time, and time spent in after school activities (see Appendix 3).

### *Measurements and instruments*

Physical activity and sedentary behaviour were measured using two different accelerometers, ActiCal<sup>TM</sup> and activPAL<sup>TM</sup> (see Study 2).

### *Statistical analysis*

Descriptive statistics were used preliminarily. Mean, standard deviation, median and percentage were calculated in order to characterise the participants' physical activity and sedentary behaviour. In a sample of 63 paired data the Pearson's correlation test was conducted to make a comparison between sedentary behaviour and physical activity of teachers and children. The Student t-test was carried out to determine if there were any differences in the mean of teachers' and children's behaviours.

## CHAPTER 5: Results

### **Brief description of New Zealand public schools**

The “Health and physical education curriculum in New Zealand” provides guidelines to develop children’s skills for use in play, games, formal exercise, dance, sport and daily life. Schools are equipped with basketball and netball hoops, tennis, volleyball and badminton nets on play courts for teaching physical education modules. There are large grass playgrounds at each school for athletics, cricket, baseball, rugby, soccer and hockey that are used for seasonal sport programs. Most schools have playground equipment, indoor gymnasiums, asphalt courts and covered outdoor play areas.

New Zealand schools provide three 30 min physical education classes per week, Jump-jam dancing classes also occur once or twice a week comprising of aerobics for 10-15 min, and 20 min morning play and 60 min lunch breaks.

### **5.1. Teachers’ physical activity and sedentary behaviour at work**

In this section qualitative data on teachers’ physical activity and sedentary behaviours at work, including the identification of barriers, facilitators, patterns of activity and inactivity, and practical solutions to increasing physical activity and reducing sedentary behaviour are reported.

School culture and physical and social environments were also considered to better understand teachers’ perspectives. School culture, defined as a set of values, beliefs,

customs, rituals, symbols and language shared by a group of people (Hargreaves, 1995), is an element that determines the actions within the organisation. It is important to explore these aspects in order to better understand the behaviour and practices of teachers at the school environment. In addition, the physical environment (buildings, neighbourhood, and space) impacts on the person's behaviour, and may facilitate or limit the opportunities to be active. Three themes emerged from the teachers' interviews:

- 1. school is an active workplace,**
- 2. teaching style and role modelling are linked to physical activity at school, and**
- 3. different priorities, classroom space and job demands are common barriers to being active at school.**

#### *Theme 1: School is an active workplace*

Teachers recognised that there were numerous opportunities to be active while working. The job demands, particularly, often required a physical involvement by the teachers. Being part of children's activities was recognised as a good opportunity to move as well as develop a sense of closeness with the children. Sharing learning responsibilities generates a feeling of acceptance, trust, belonging and commitment. The school environment (generally a large space) and personal aspects (awareness of the benefits of being active) were also key factors to increasing physical activity while working.

Job demands and work-related activities provided an opportunity for teachers to be active while working. Many activities were integrated in the formal curriculum, and



other extracurricular activities, such as clubs and sports, offered a great opportunity to engage in physical activity. The physical activity school programmes, or physical education classes, provided further opportunities for teachers to move, as did duty responsibilities at break times where teachers reported walking for the duration:

*“Yeah, well our programmes are set up to umm.... for the classes to be active because of the way we have aerobics or fitness in the morning and we have a sports programme, we have lunch time sports. We have a special physical education session in the afternoon so in terms of the children there is plenty of ways for them to move around a bit and the teachers are with them doing that so yeah...”*

*“...when you are on duty at lunch time, that’s the chance for you to walk for 25 minutes because you should be walking all the time...”*

Ideas from teachers in relation to being more active at work included a walk at lunchtime, “the walking club”, or taking a sports group, and ensuring that in each block of class time some sort of physical activity was performed to get everyone moving. In terms of personal commitment, teachers reported that *“to force themselves to go and do something and move”*, could get them moving.

#### *Teachers’ work demands*

Primary school teaching is a highly demanding occupation, both physically and mentally, though this can vary depending on teaching style, job demands and

expectations. Interestingly teachers perceived that they move more today than they did in the past, primarily because current teaching practices require them to be increasingly involved physically while teaching. However, there was variability in the responses with respect to how physically demanding nature of primary teaching. Some of the teachers interviewed viewed teaching as less physically demanding:

*“Umm...teaching.....physically, teaching is not a tiring, I don't think teaching is a tiring job but it is mentally tiring and stressful so at the end of the day, you feel physically tired, ... , I think physical activity is greater than an office job because very rarely will a teacher be sitting the whole day. Up down, moving around but it is not, I would say it is mid range for a job”*

*“I guess we don't have that hard level of physical activity, but we must move a fair bit ... I think people move around inside the classroom a lot more than what people think we do, you're constantly up and down, and moving around, but you're not doing any heavy lifting, you're not moving for great distances at a time, you're just going from one part of the room to the other pretty much“*

Teachers are constantly moving as part of the teaching requirements, especially in the junior school, where teachers must be close to the children to ensure that they are safe and to show them what to do. Unlike senior school teachers to stay in one place is much more difficult for junior school teachers, because small children move around a lot more and teachers have to move with them.

*“...every teacher is required to teach the children swimming, and I would say, the teachers' participation in that is limited, because they're not in the water, but they still have to move around the pool and things...*

*But they [children] do have swimming with their class teacher, and athletics with their class teacher, and fitness with their class teacher, so the class teacher is still providing some PE [Physical Education], but they don't provide the specialist PE”*

*“... according to the levels, I think as you go further up the school, teachers are able to sit more, but with the younger children you're sort of dealing with lots of issues that come up and you're sort of fighting fires and helping children and rushing over there, so to me that makes quite the difference, the level you teach.”*

Class organisation provides a good opportunity for teachers to be active. While generally, the first part of the morning block class is devoted to sitting and explaining activities, in the second part teachers are moving around the classroom assisting the children.

*“you're in your classroom teaching so you'll probably spend the first portion of the morning sitting because you're explaining what the children are doing so ...and then the 2<sup>nd</sup> part of that morning block , you'll probably be moving around the classroom helping and assisting the children.”*

In order to ensure better learning, most of the more difficult subjects, such as mathematics, English and sciences, are taught in the morning leaving the later part of the day for subjects that are less mentally demanding, but involve more physical activity:

*“... the last block is more of a movement thing in the afternoon, that last hour of school is ... umm ...we would do singing or dancing or sport on a Wednesday so it's more of a movement session...”*

Teachers provide children with learning tasks and opportunities for all subjects, including physical education and scheduled physical activities such as morning fitness sessions. It is the responsibility of each classroom teacher to provide opportunities for children to be involved in movement.

*“...junior school children have fitness in the morning, which is about... can be about 10 to 15 minutes a day and the teachers are participating in that as well...”*

*“...with the aerobics, well definitely the aerobics, in the junior schools the teachers lead it and they do it.”*

Lunchtime activities also allow teachers to be active. Coaching sports or leading a club requires teachers to move. Duty hours are another important opportunity for teachers to move. Teachers commonly are asked to do complete school ground duties three to four

times a week for a half hour, during each they supervise children at lunchtime and other breaks. This necessarily involves walking and standing.

*“...when you are on duty at lunch time, that’s the chance for you to walk for 25 minutes because you should be walking all the time”.*

*“So when you have a duty, you’re just walking around the playground the whole time.”*

*“...they have duties so actually if they are on duties, they are walking around anyway.”*

#### *Physical school environment*

The school environment per se further opportunities for teachers to be active. The physical dimensions of schools favour displacement, for example walking between the classroom and other school facilities (staff room, office, sport field).

*“I think there was no physical features of our school, of the environment that stops teachers from being active”*

*“Ummm I think more so because the classes are out of their rooms a lot so if you’re in the classroom as a teacher, you’re taking the children out to PE or to library sessions or to ICT so you’re moving between rooms a lot and then you’ve got the morning tea break and then little...there is another short little break for*

*kids to get up and run around and so I think..yeah there is plenty of opportunity to move around”*

### *Personal options*

Physical activity and its benefits are recognised as an important aspect of the children’s growth and development. Children are encouraged to participate in sport clubs, have active breaks, and be conscious about the physical activity benefits and strategies that can increase physical activity. Teachers recognise that being active themselves can influence the children’s behaviour.

*“Depends...depends on how you approach it...I will I.....personally...I mean this class, we do, we do pretty much PE , we do a lot of...so I...I....say, on ...it will be on average...average...average...yeah”*

*“Because it’s really important for our kids...yeah especially when they’re working. Have a bit of break.....a bit of physical break and then come back and work again. So it is highly encouraged and ...but not everyone is a 100% buying in.”*

*“Umm...I think it depends on the style of teaching that a teacher does. Umm...some children...some teachers might engage more times with the children at their point of learning and that involves moving around the classroom.”*

## *Theme 2: Teaching style and role modelling are linked to physical activity at school*

### Teaching style

Teaching style certainly determines the level of movement of teachers. For example, older styles of teaching are often associated with a rather sedentary outlook (teachers teaching from behind the desk), whereas most modern day teaching styles require an intellectual, physical and emotional commitment by the teachers.

*“We here are not encouraged to sit in the chair all day because that is not teaching... there is a couple who probably I would say sit at their table for longer than they need to sit at a table... its the old style. That is the old way of teaching”*

*“I think the way that teaching is now, you do more interaction with the children where, especially with the little ones... well now with all the children while you are walking around the room constantly”*

Teachers who become aware of the benefits of physical activity and who incorporate physical activity into their teaching routine, give children more opportunities to be active.

*“Because it’s really important for our kids...yeah especially when they’re working. Have a bit of break.....a bit of physical break and then come back and*

*work again. So it is highly encouraged and ...but not everyone is a 100% buying in.”*

Regarding personal commitment, some teachers teach by sitting down and children come to them, usually at senior school where an instruction is given and the students act on it. Having sedentary breaks appears as a practicing behaviour for teachers when they are not on duty.

*“If we're not on duty we are in the staff room drinking coffee and talking, and then at lunch time we supervise the children's eating time and then we, well, may be going to the staff room and prepare lunch. I usually work through my lunch time, I go back to my room and work normally, ... if you're not up on duty, you can escape. Sounds terrible!! You can have a break, if you just close your classroom door or sit in the staff room”*

Teaching style is determined by personal preferences, priorities, self-confidence level and gender. Sometimes teachers feel that they do not have the confidence to teach physical education because they do not have any specific training. When workload increases, the first thing most teachers would do is drop physical activity, particularly if they are busy or worried about children's academic performance.

*“I think for a lot of teachers, female teachers especially, it is sad to say, they don't often enjoy going out to take PE, and I think, as a teacher, you need to*



*have a lot of energy to take... to teach PE with young children, ... for a lot of teachers they all just think: "No, I can't face PE today".*

### *Role modelling*

As teaching is a giving profession, personal commitment is all important. Teachers recognise themselves as role models who play an integral part in teaching children and shaping their knowledge and understanding on an active lifestyle. Engaging children in different activities, motivating them and reinforcing the benefits of physical activity, are part of the teacher's role. Teachers are aware that they themselves must move to motivate children to move.

*"Well we do jump jam and we do it with the children because if the children see us doing it then they want to do it... I think...you know the thing is that you need to be able to do it with the children because...I mean you're role modelling to them that it is not scary because a lot of them found it really overwhelming so if you're prepared to do it with the children then it's not so hard for them"*

At early ages, children learn more by imitation, especially from teachers, coaches or older peers, so role modelling at this stage is a vital tool to stimulate student learning. Teachers understand that having an active and healthy lifestyle can result in a feeling of happiness and life balance, which is reflected in their everyday activities and which can then influence children's behaviours and learning.

*“So we’re involved in that and with where I teach , we always start with a song in the mornings, you know a movement song and in the afternoons we do that again so for me, in the classroom actually do , we do more movement then sitting down. It’s probably half and half but the movement side is really important and I do that with all the children”*

*“...because we have to stand up the front model at a level, so I think we are talking more about getting children moving and not having them sit on the mat for very long...”*

*“Ummm.....so it’s better that teachers have a really well rounded balanced life and part of that is being healthy and exercising”*

*Theme 3: Different priorities, classroom space and job demands are common barriers to being active at school*

The teachers interviewed recognised some aspects of their teaching roles that make it difficult to be active at work, such as school policies on physical activity, curriculum obligations, weather, technology, teaching style, and the built environment.

*Barriers of physical activity at work*

The barriers of physical activity at work that were reported by the teachers studied can be summarised into three categories: personal, environment, and job demands. In isolation, these barriers can be addressed, but where there is a combination of barriers,

the task is more difficult. The teachers studied identified lack of interest, priorities and laziness as personal barriers to partaking in physical activity at work:

*“most of the teachers would say that if their day is busy, the first thing they would drop off would be the PA [Physical Activity] because is ... to be more important that they have their reading or their math or their writing”*

*“Time (laughs). Having to do everything is really hard...yeah very hard. You’ve got to cover so many things that ...that...and generally, physical activity is the first thing a teacher would drop”*

*“My normal hours are about 7.30 until... probably the earliest I leave is five, but then I go home and I do more work at home, a lot of computer work in the evenings and also at the weekends. I think a lot of teachers would do a few hours at the weekend as well”*

*“...we have meetings twice a week so I am here till 4.30 twice a week . And in that...so the day we have meetings, you will be sitting the whole time ...generally.”*

A confined and cluttered classroom appears to be a barrier to teachers and their children engaging in movement. A spacious classroom would allow teachers to be more creative, move around more freely and encourage the children to move more. Cumbersome furniture is not conducive to this:

*“I suppose the chairs...I mean you look at the size of the chairs....there is not much room to be free. I mean if I was going to do dance or drama or I wanted “oh, lets all get up and lets do something” ...you’ve got to move the furniture out of the way to create the space. ....the furniture is restricting but what can you do at the moment. There is not a lot you can do”*

Work demands, including contact teaching time, lesson preparation, marking, and lesson improvements, consume the majority of teachers’ time. And technology, which is a tool designed to assist teachers in new work functions, has exacerbated, rather than alleviated, the barriers to teachers becoming more active. The new school curriculum demands and national standard quota meant that teachers need more time to prepare and feel the pressure to perform well in their tasks.

*“I think technology doesn't help obviously, with computers, ... , probably I save myself time by having the printer there, and I think, probably who saves ourselves time, obviously using technology, but this means we're moving less”*

*“I think the only difficulty we have is an overcrowded curriculum, teachers are busy, teachers are stressed”*

Teachers spend additional time sedentary before and after teaching time and even in the weekends when they are involved with meetings and preparation for class.

*“...the hour between you would arrive and you would start school, you would “flatting” on your computer or you would be organizing things in your classroom...we have meetings twice a week so I am here till 4.30 twice a week . And in that... so the day we have meetings, you will be sitting the whole time ... generally”*

Some class activities and the teaching of some subjects are performed while seated, for example explaining tasks to individual children.

*“...you’re in your classroom teaching so you’ll probably spend the first portion of the morning sitting because you’re explaining what the children are doing so ... and then the 2<sup>nd</sup> part of that morning block , you’ll probably be moving around the classroom helping and assisting the children”*

The requirements of the national standards affect teachers’ active behaviour too; the increase in workload, due to assessment procedures and reporting, means teachers have less time to be active:

*“I think things that are national standards have caused a lot of professional development that caused us to change a lot of systems in the school, a lot of assessment procedures, a lot of reporting for parents procedures, and all of those things have meant having meetings, and having discussions, drafting reports and getting them approved by staff, and changing them again, and*

*getting them approved by parents, and changing them again. It's all just this cycle of change”*

Teachers’ commitment to providing high levels of education so children learn and achieve to the expected level for each year is extremely demanding in terms of time. Add to this high class numbers and the demands are greater. To meet the demands and it this continual need to change and adapt, teachers adopt various strategies:

*“I think it's the high... we place a lot of the work on ourselves to be honest. ... Teaching has got a huge amount of change. Nothing ever stays the same in teaching and it's because of that it's extremely stressful stuff.”*

In summary, teachers identified eleven ways that they could be physically active during school hours. Some were very obvious like joining in jump-jam and physical education classes, providing playground supervision for students, and being active with children at lunch time.

Teachers also identified facilitators that they would like to use like changing classroom layout, allowing children to be active during class lessons, changing their teaching style to encourage physical activity and having a personal commitment to role model active behaviours.

Teachers also identified 16 practical ways to increase their activity and students' activity including sports clubs, coaching, and active breaks during class lessons, using active breaks as a reward for good student behaviour, and involving parents by providing physical activity as homework for parents and their children.

## **5.2. Teachers' workplace physical activity, sedentary behaviour patterns and cardiovascular risk profile**

The first part of this section reports on teachers' workplace physical activity and sedentary behaviour patterns, teachers' occupational wellness, physiological aspects of sedentary behaviour, the school environment and job requirements. Here the relationships between the physical activity level and sedentary behaviours of teachers while at work are described. Also the trends of active and sedentary behaviours while at work are shown. The second part reports on the teachers' cardiovascular risk profile, showing how physical activity may be protective and sedentary behaviours may be harmful regarding cardiovascular diseases. Teachers' demographic, anthropometric, physical activity, sedentary behaviour and blood data are shown in Table 18.

### *Teachers' physical activity and sedentary behaviour levels*

Teachers' physical activity level (Table 18), categorised according to intensity, showed that teachers spent more time in moderate to vigorous physical activity (MVPA), at work (18%) than out-of-work (11%). A similar trend was observed for light activity time. The difference between the time at-work and the time out-of-work was also significant ( $p < 0.0001$ ).

Teachers were more active at-work than out-of-work ( $p < 0.001$ ), performing more steps (609 steps/h at-work, 546 steps/h out-of-work) and expending more energy (44.4 kcal/hour at-work, 31.1 kcal/h out-of-work) (Table 18). On average, interruptions in sitting time were significantly higher ( $p < 0.0001$ ) during work-time (42 times/day) than out-of-work (24 times/day).



In our sample of teachers, 100% met the physical activity recommendation of greater than 150 min of moderate to vigorous activity per week. The 150 min was achieved in three working days. The moderate intensity activity was not calculated in 10 min bouts.

**Table 18: Teachers' demographics, anthropometrics, physical activity and sedentary behaviours and blood parameters.**

Variable	Male (n = 12)			Female (n=91)			Total (n = 103)			
	Mean	SD	Min-Max	Mean	SD	Min-Max	Mean	SD	Min-Max	
Age (years)	41.8	9.6	26 - 61	42.6	12.2	22 – 63	42.5	11.9	22 - 63	
Years Working	11.8	9.1	1 - 29	13.1	10.3	1 - 40	12.9	10.1	1 - 40	
Anthropometric										
Weight (kg)	84.8	14.4	60-110	69.8	14.6	48-115	71.5	15.3	48-115	
Height (cm)	1.78	0.06	1.71-1.89	1.66	0.07	1.53-1.82	1.67	0.08	1.53-1.89	
BMI (kg/m <sup>2</sup> )	26.6	4.4	20.3–35.3	25.4	5.4	19.1-44.4	25.6	5.3	19.1-44.4	
Waist (cm)	88.0	11.8	70-110	77.7	12.6	55-122	78.9	12.9	55-122	
Hip (cm)	102.9	6.6	91-113	102.6	11.0	85-138	102.7	10.5	85-138	
WHR	0.85	0.06	0.75-0.97	0.76	0.07	0.54-0.98	0.77	0.07	0.54–0.98	
Physical activity and sedentary behaviours	At-work			Out-of-work			Total			<i>p</i> value
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	
Awake time (h/d)	9.22	0.96	9.22	6.78	1.42	6.79	16.00	0.79	16.00	0.001
Sitting time** (h/d)	5.05	1.43	5.19	3.89	1.30	3.87	8.94	1.76	9.08	0.001
Standing time** (h/d)	3.97	1.10	3.99	2.46	1.07	2.50	6.43	1.63	6.38	0.001
Sedentary time*(h/d)	5.40	1.23	5.22	4.61	1.29	4.69	10.01	1.49	10.09	0.001
Steps counts*(steps/d)	5619	1970	5616	3701	2592	3110	9320	3192	8697	0.001
Stepping time** (h/d)	1.10	0.42	1.12	0.72	0.42	0.62	1.82	0.60	1.75	0.001
EE *(kcal/d)	409	158	392	211	157	176	630	218	601	0.001
Transition count** (times/d)	42	14	44	24	10	24	66	17	66	0.001
Light activity time* (h/d)	2.72	0.67	2.77	1.50	0.68	1.42	4.22	0.91	4.17	0.001
MVPA time* (h/d)	1.65	0.59	1.63	0.77	0.53	0.69	2.42	0.76	2.42	0.001
Blood parameters (mmol/L))										
Glucose	5.4	0.5	4.6-6.20	5.2	1.1	3.8-13.9	5.3	1.1	3.8-13.9	
Triglycerides	1.32	0.96	0.85-4.17	1.40	0.80	0.80-5.83	1.39	0.82	0.80-5.83	
Total Cholesterol	4.92	0.49	4.03-5.92	5.23	0.76	4.08-7.36	5.17	0.72	4.03-7.36	
Blood pressure (mmHg)										
Systolic	127	10	110-142	120	13	100-160	121	13	100-160	
Diastolic	82	15	60-100	78	11	56 – 100	78	11	56 – 100	
Heart rate (bpm)	65	9	52-81	68	9	46 - 90	67	9	46 - 90	

Assessed by: \*ActiCal, \*\*activPAL

*p* value: significantly different at-work from out-of-work activities

Teachers spent nearly 58% of their work time sedentary, as measured by the ActiCal<sup>TM</sup> accelerometer, which does not differentiate between sitting and standing (Table 18). The majority of this sedentary time was spent sitting (55%), as measured by the activPAL<sup>TM</sup> accelerometer. A comparison of the at-work and out-of-work data revealed

that teachers were significantly ( $p < 0.01$ ) more sedentary out-of-work (68% of the time) in comparison with at-work (59%).

When comparing activity data between deciles, teachers who worked at the lower decile schools were marginally more sedentary (63% of their awake time) than those who worked at the higher decile schools (62%). The latter spent marginally more time in light activities (27%, 26% respectively), but both spent 15% of their time in MVPA. In the lower decile group, a greater number of steps were taken (9,328 vs. 9,316 step/day) and EE (640 vs. 625 kcal/day) than in the higher decile group. However, no significant differences were found in physical activity parameters between the groups (data not shown).

#### *Teachers' physical activity and sedentary behaviour: day-by-day trend*

Physical activity and sedentary behaviour levels were consistent between days ( $p > 0.05$ ). The average daily time spent stepping at-work was 7% of total awake time, in light intensity activities was 17%, and in MVPA was 11%.

Day 3 appeared least active, with the highest percentage of sitting time (57%), followed by Day 2 with a 63% in sedentary activity. In contrast, the most active day was Day 1, with the highest percentage of MVPA time (16%), stepping time (12%), step counts ( $10,064 \pm 4,377$  steps/day) and more energy expended ( $637 \pm 248$  kcal/day). Transitions from sitting to standing were the highest on Day 3 ( $69 \pm 20$  times/day).

*Physical activity and sedentary behaviour as protective and risk factors*

Teachers who stood more during the day showed lower probability of developing high cholesterol and lower probability of developing CVD than those who accumulated less standing time during the day (Table 19). Moreover, this research showed that those teachers who accumulated more standing time at-work had lower probability of developing cardiovascular diseases in the next 10 years than teachers who accumulated less standing time. Cardiovascular risk for the next 10 years was calculated based on the teacher's blood parameters measured using the Cardiovascular Risk Assessor (Society et al., 2005).

Teachers who accumulated greater transitions from sitting to standing and vice versa along the day showed lower probability of developing high triglycerides and high total cholesterol than those who accumulated a lesser number of transitions across the day. Furthermore, teachers who accumulated more stepping time during the day showed lower probability of developing high total cholesterol than those who accumulated less stepping time. Teachers who spent more time walking at-work showed lower probability of developing cardiovascular diseases than those who spent less time walking at-work.

Teachers who accumulated more time in light activities showed lower risk of developing cardiovascular disease, systolic and diastolic, than teachers who accumulated less light physical activity during the day. Those teachers who accumulated more light activity time at-work showed 0.9 times lower probability of developing high triglycerides concentration than those teachers who accumulated less

light physical activity time at-work, with 95% confidence that the true value of the mean for high triglycerides was located in the interval from 0.01 to 0.98.

Teachers who accumulated more MVPA time showed lower probability of overweight-obesity and cardiovascular risk than teachers who accumulated less MVPA time during the day. It was also found that teachers who accumulated more MVPA time at-work showed lower risk of overweight-obesity, cardiovascular risk, and hypertension (diastolic) than teachers who accumulated less MVPA time at-work.

**Table 19: Active Behaviours as protector factors (OR)**

	Total			At-work			Out-of-work		
	Risk	95% CI		Risk	95% CI		Risk	95% CI	
<b>Standing Time</b>									
<i>High cholesterol</i>	<b>0.477</b>	0.112	2.033	<b>0.500</b>	0.117	2.132	<b>0.236</b>	0.046	1.204
<i>% CVD systolic</i>	<b>0.551</b>	0.241	1.260	<b>0.784</b>	0.345	1.779	<b>0.530</b>	0.231	1.217
<i>% CVD diastolic</i>	<b>0.554</b>	0.244	12.59	<b>0.784</b>	0.348	1.768	<b>0.641</b>	0.283	1.451
<b>Stepping Time</b>									
<i>Hypertension systolic</i>	<b>0.976</b>	0.315	3.030	<b>1.075</b>	0.346	3.337	<b>0.976</b>	0.315	3.030
<i>High cholesterol</i>	<b>0.763</b>	0.191	3.040	<b>0.880</b>	0.221	3.508	<b>0.433</b>	0.102	1.849
<i>% CVD systolic</i>	<b>0.840</b>	0.370	1.905	<b>0.731</b>	0.322	1.661	<b>0.530</b>	0.231	1.217
<i>% CVD diastolic</i>	<b>1.000</b>	0.444	2.251	<b>0.730</b>	0.323	1.647	<b>0.641</b>	0.283	1.451
<b>Transitions</b>									
<i>High triglycerides</i>	<b>0.364</b>	0.066	2.016	<b>0.879</b>	0.182	4.255	<b>1.376</b>	0.285	6.658
<i>High cholesterol</i>	<b>0.800</b>	0.201	3.188	<b>0.880</b>	0.221	3.508	<b>0.800</b>	0.201	3.188
<b>Steps Count</b>									
<i>Hypertension systolic</i>	<b>0.977</b>	0.316	3.022	<b>0.733</b>	0.235	2.289	<b>0.700</b>	0.224	2.186
<i>High cholesterol</i>	<b>0.365</b>	0.088	1.504	<b>1.023</b>	0.276	3.788	<b>0.365</b>	0.088	1.504
<i>% CVD systolic</i>	<b>0.905</b>	0.406	2.015	<b>0.476</b>	0.211	1.075	<b>0.765</b>	0.343	1.708
<i>% CVD diastolic</i>	<b>0.909</b>	0.411	2.013	<b>0.480</b>	0.214	1.077	<b>0.771</b>	0.48	1.710
<b>Light activity time</b>									
<i>Hypertension diastolic</i>	<b>0.792</b>	0.306	2.046	<b>1.263</b>	0.489	3.264	<b>0.792</b>	0.306	2.046
<i>High triglycerides</i>	<b>2.143</b>	0.387	11.857	<b>0.111*</b>	0.013	0.977	<b>1.375</b>	0.285	6.635
<i>% CVD systolic</i>	<b>0.739</b>	0.330	1.654	<b>1.717</b>	0.763	3.863	<b>0.875</b>	0.392	1.953
<i>% CVD diastolic</i>	<b>0.878</b>	0.395	1.949	<b>1.443</b>	0.648	3.214	<b>1.036</b>	0.467	2.299
<b>MVPA time</b>									
<i>Overweight-obesity</i>	<b>0.864</b>	0.388	1.924	<b>0.576</b>	0.256	1.292	<b>0.730</b>	0.327	1.631
<i>CVRisk</i>	<b>0.695</b>	0.275	1.761	<b>0.525</b>	0.205	1.348	<b>1.083</b>	0.432	2.717
<i>Hypertension diastolic</i>	<b>1.219</b>	0.464	3.199	<b>0.555</b>	0.207	1.489	<b>0.957</b>	0.365	2.511
<i>% CVD systolic</i>	<b>1.089</b>	0.483	2.456	<b>0.696</b>	0.308	1.573	<b>0.917</b>	0.407	2.066
<i>% CVD diastolic</i>	<b>0.910</b>	0.406	2.039	<b>0.587</b>	0.260	1.323	<b>0.910</b>	0.406	2.039

\* Significantly protective factor of getting high triglycerides concentration

The odds of developing hypertension was higher in teachers who accumulated more sitting time (measured with the activPAL<sup>TM</sup> accelerometer) than those who accumulated less sitting time during the day (Table 20). This probability increased in those teachers who accumulated more sitting time out-of-work than those who spent less time sitting out-of-work. Moreover, it was found that teachers who accumulated more sitting time during the day increased their probability of developing cardiovascular disease in the next 10 years than those teachers who accumulated less sitting time. These values were increased in teachers who remained seated for longer periods during the day. For

percentage of getting a cardiovascular disease, systolic and diastolic, their CI were over OR=1, indicating that the probability is significant.

It was found that teachers who accumulated more time in sedentary activities showed greater risk of developing hypertension (systolic and diastolic) than teachers who accumulated less time in sedentary activities over the day. Likewise, teachers who accumulated more sedentary activity time at-work showed greater risk of developing a CVD than those who accumulated less sedentary activity time at-work.

**Table 20: Sitting and sedentary activity time as a risk factor (OR)**

Sitting Time#	Total			At-work			Out-of-work		
	Risk	95% CI		Risk	95% CI		Risk	95% CI	
<i>Hypertension diastolic</i>	<b>1.800</b>	0.662	4.897	<b>0.840</b>	0.313	2.255	<b>2.008</b>	0.723	5.578
<i>Overweight-obesity</i>	<b>1.018</b>	0.452	2.293	<b>1.209</b>	0.536	2.724	<b>1.167</b>	0.517	2.631
<i>% CVD systolic</i>	<b>2.538*</b>	1.087	5.928	<b>1.473</b>	0.646	3.360	<b>2.805*</b>	1.204	6.537
<i>% CVD diastolic</i>	<b>2.476*</b>	1.071	5.724	<b>1.453</b>	0.642	3.290	<b>2.778*</b>	1.201	6.422
<b>Sedentary Activity Time&amp;</b>									
<i>CV Risk</i>	<b>1.640</b>	0.648	4.150	<b>2.471</b>	0.944	6.463	<b>0.643</b>	0.254	1.626
<i>Hypertension systolic</i>	<b>2.070</b>	0.641	6.686	<b>1.000</b>	0.323	3.095	<b>1.000</b>	0.323	3.095
<i>Hypertension diastolic</i>	<b>2.773*</b>	1.018	7.558	<b>2.042</b>	0.769	5.419	<b>1.263</b>	0.489	3.264
<i>High triglycerides</i>	<b>1.462</b>	0.303	7.058	<b>0.684</b>	0.142	3.300	<b>0.875</b>	0.181	4.224
<i>% CVD systolic</i>	<b>1.143</b>	0.512	2.554	<b>2.431*</b>	1.066	5.543	<b>0.624</b>	0.278	1.401
<i>% CVD diastolic</i>	<b>0.966</b>	0.435	2.143	<b>2.402*</b>	1.061	5.439	<b>0.531</b>	0.237	1.192

\* $p < 0.05$ ;

#Sitting time was measured by activPAL and considered only when the participant was in a sitting/lying position;

&Sedentary Activity time was measured by ActiCal and considered all activities less than 1.5 MET and can include sitting and standing positions.

### *Teachers' cardiovascular disease (CVD) risk*

To determine the risk of developing cardiovascular disease, anthropometric, blood, and behavioural factors were analysed. The three most prevalent risk factors of developing

cardiovascular disease (Table 21) were obesity, impaired blood lipids, and high blood pressure. The study group was between 8% and 13% at risk of developing a CVD in the next 10 years.

Table 21: Teachers' risk factor prevalence

Parameters			n of cases	%	<i>p</i>
Blood pressure	Optimal		92	89	0.001
	Hypertension		11	11	
BMI	Optimal		60	58	0.001
	Overweight		25	24	
	Obesity		18	17	
Smoker	Yes		5	5	0.001
	Not		98	95	
Blood lipids	Total cholesterol ( <i>n</i> = 99)				0.001
		Optimal	57	58	
		Borderline	32	32	
		High	10	10	
	Triglycerides ( <i>n</i> =75)				0.001
		Optimal	62	83	
		Borderline	5	7	
		High	7	9	
		Very High	1	1	
	Blood glucose ( <i>n</i> =102)				0.001
		Optimal	85	83	
		Early diabetes	15	15	
		Diabetes	2	2	
CV Risk	Systolic	High (> 10%)	8	8	0.001
		Low (< 10%)	95	92	
	Diastolic	High (> 10%)	13	13	0.001
		Low (< 10%)	90	87	

*p* < 0.01

In summary, teachers spent more time in MVPA at work than out of work, and they were more sedentary out of work than while at work. Despite that more than half of the time at school was seated, teachers were able to accumulate more energy expenditure while at work than out of work. Physical activity and sedentary behaviours shown constant values during the measurement time determining a trend for this sample of teachers.

It was identified that accumulating more time standing and interrupting sedentary behaviours constantly the cardiovascular risk for the next 10 years is reduced. Accumulating more light intensity activity time at work emerged as a significant protective factor to do not get harmful concentration of triglycerides in the blood stream. Teachers who showed highest levels of sedentary behaviours presented a trend to increase their cardiovascular risk.



### 5.3. Self-reported physical activity and perceived workload and productivity analysis

This section reports the teachers' perception of the impact of their workload on habitual physical activity, which was assessed through two questionnaires: the Questionnaire for the measurement of Habitual Physical Activity (QHPA) and the World Health Organisation Health and Work Performance Questionnaire (HPQ). The report includes a descriptive analysis of both questionnaires followed by a comparative analysis of objective and self-reported data.

#### *Teachers' Habitual Physical Activity Index*

The habitual physical activity index was calculated using the Baecke questionnaire, determining three different dimensions related to occupational physical activity, sport activities, and non-sport leisure activities.

Teachers were classified into the moderate habitual physical activity index categories according to their score in each of the three dimensions, as shown in Table 22.

Table 22: Teachers' habitual physical activity index during various daily activities

Index	n	Work Activity	Sport Activity	Leisure Activity	Total Score
Means	101	2.74	2.71	2.65	8.05
SD		0.31	0.94	0.62	1.29
Classification		Moderate	Moderate	Moderate	Moderate

Significant differences in the sport index were found between the youngest and oldest teachers ( $p=0.006$ ), and in the total HPA index ( $p=0.03$ ). Among the youngest and

middle age teachers, significant differences were found only in the work index ( $p=0.037$ ). Furthermore, no significant differences were found in all indices when gender and deciles were analysed.

Table 23: Distribution of teachers' physical activity indices by age groups (mean  $\pm$  SD)

Age group	n	Work Index	Sport Index	Leisure Index	Total Index
< 36	33	2.84 $\pm$ 0.33*	2.95 $\pm$ 0.66*	2.63 $\pm$ 0.68	8.38 $\pm$ 1.25*
36 – 49	34	2.68 $\pm$ 0.30	2.81 $\pm$ 1.04	2.64 $\pm$ 0.59	8.08 $\pm$ 1.24
> 49	34	2.69 $\pm$ 0.28	2.37 $\pm$ 0.98	2.68 $\pm$ 0.62	7.70 $\pm$ 1.33

\* $p < 0.05$

The majority of teachers indicated that they sometimes sat at-work (64%), but most of them remained standing (64%) or walking (61%). While teachers reported their lifted heavy loads at-work (62%), they sometimes (41%) or often (35%) felt tired after work. Likewise, 42% of teachers indicated that seldom sweated at-work, and 35% reported they did so sometimes. When asked about physical demands, 54% of teachers indicated that their physical workload was as demanding as others of the same age.

Sixty five percent of those studied reported participating in one or more sports, at least 1-2 hours per week, and for more than nine months of the year. Running was the most popular activity (20%), followed by playing soccer and going to the gym (14%). Those who participated in more than one sport, reported running and going to the gym as their alternative (17%), spending on average between 1-2 hours per week on that activity, for more than nine months of the year.

When participants were asked if they watched television during their leisure time, most reported they did sometimes (53%). When asked about walking during leisure time, the

most frequent answer was sometimes (40%). More than 60% of teachers indicated that they never rode a bike in their leisure time.

The average time spent performing locomotion activities (walking and/or cycling to work and shopping) was less than five minutes (28%), followed by the period between 5 to 15 minutes a day (25%).

#### *Teachers' work performance level*

Table 24 presents the mean values for absolute and relative absenteeism, and absolute and relative presenteeism. These data reveal that the teachers studied had high work productivity compared to others in the same occupation (88%), and a high percentage (63%) of extensionism (working longer hours than expected), represented by negative values of relative absenteeism. The reported actual hours worked in a week was  $49.2 \pm 8.1$  hours that was 5.7 hours over the work hours expected by the employer ( $43.7 \pm 6.5$  hours). Over half of the sample of teachers reported working for more than 50 hours per week (57.6%).

Table 24: Teachers' absenteeism and work performance by gender, decile, and age group

	N	Absolute absenteeism* (mean $\pm$ SD)	Relative absenteeism* (mean $\pm$ SD)	Absolute work performance $\diamond$ (mean $\pm$ SD)	Relative work performance $\dagger$ (mean $\pm$ SD)
Total	92	-5.6 $\pm$ 8.3	-0.1 $\pm$ 0.2	79.9 $\pm$ 11.0	1.0 $\pm$ 0.1
Male	12	-5.0 $\pm$ 7.5	-0.1 $\pm$ 0.2	74.2 $\pm$ 9.0	1.0 $\pm$ 0.1
Female	80	-5.7 $\pm$ 8.4	-0.1 $\pm$ 0.2	79.6 $\pm$ 11.2	1.0 $\pm$ 0.1
Lowest decile	30	-5.3 $\pm$ 8.5	-0.1 $\pm$ 0.2	81.3 $\pm$ 11.4	1.1 $\pm$ 0.2
Highest ecile	62	-5.8 $\pm$ 8.3	-0.2 $\pm$ 0.2	77.7 $\pm$ 10.8	1.0 $\pm$ 0.1
< 36 y.o.	33	-6.3 $\pm$ 8.4	-0.2 $\pm$ 0.2	76.4 $\pm$ 12.5	1.0 $\pm$ 0.2
36 – 49 y.o.	31	-4.7 $\pm$ 9.1	-0.1 $\pm$ 0.2	77.4 $\pm$ 10.0	1.0 $\pm$ 0.1
> 49 y.o.	28	-5.9 $\pm$ 7.3	-0.1 $\pm$ 0.2	83.6 $\pm$ 9.1**	1.0 $\pm$ 0.1

\* *Absolute absenteeism: actual worked hours - the expected worked hours*

▪ *Relative absenteeism: absolute absenteeism/expected worked hours*

$\diamond$  *Absolute work performance: reported own performance converted into percentages*

$\dagger$  *Relative work performance: reported performance/average performance in the same job*

\*\*  $p < 0.05$

Significant differences in the absolute work performance were found between the oldest and youngest teachers ( $p=0.012$ ). Differences were also found between the oldest teachers and middle age teachers in terms of absolute work productivity ( $p=0.017$ ). Subgroups according to gender, age or decile were similar for other indices.

With respect to absenteeism, only 7% of the teachers reported that they had missed an entire day of work because of physical or mental health problems, and 4% had missed a work day for other reasons. A small number reported that they had missed a part of a work day because of physical or mental health problems (1%). Work-related accidents were not reported as a cause of absenteeism.

#### *Comparative analysis of objective and self-reported data*

A comparison of data obtained from accelerometers with data from self-report questionnaires was performed. Using either of these methods, accelerometry and self-

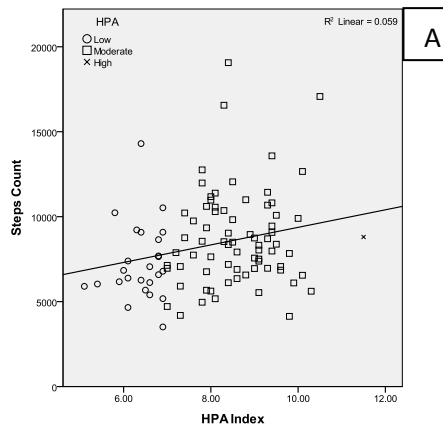
report, it was possible to classify teachers as moderately active subjects, both in general and when they were at-work (Table 25).

**Table 25: Physical activity by questionnaire and accelerometry comparison (mean  $\pm$  SD)**

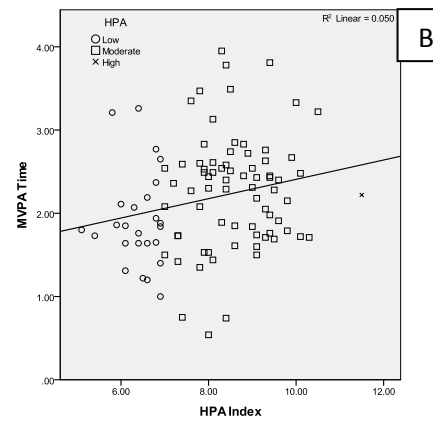
	Self report data		Objective data			
	HPA Index*	Work Index*	Daily MVPA time <sup>#</sup>	MVPA time at-work <sup>#</sup>	Daily Steps count <sup>&amp;</sup>	Steps at-work <sup>&amp;</sup>
Total	8.07 $\pm$ 1.29	2.74 $\pm$ 0.31	2.42 $\pm$ 0.76	1.65 $\pm$ 0.59	9320 $\pm$ 3192	5619 $\pm$ 1970
Male	8.32 $\pm$ 1.14	2.73 $\pm$ 0.33	2.74 $\pm$ 0.95	2.02 $\pm$ 0.77	9721 $\pm$ 3909	6754 $\pm$ 3023
Female	8.04 $\pm$ 1.31	2.74 $\pm$ 0.31	2.37 $\pm$ 0.72	1.62 $\pm$ 0.55	9264 $\pm$ 3103	5598 $\pm$ 1756
Lowest decile	8.01 $\pm$ 1.47	2.69 $\pm$ 0.29	2.42 $\pm$ 0.62	1.68 $\pm$ 0.48	9329 $\pm$ 3232	5728 $\pm$ 1612
Highest decile	8.10 $\pm$ 1.21	2.76 $\pm$ 0.32	2.42 $\pm$ 0.82	1.67 $\pm$ 0.64	9316 $\pm$ 3199	5745 $\pm$ 2127
< 36 y.o.	8.38 $\pm$ 1.25	2.84 $\pm$ 0.33	2.26 $\pm$ 0.60	1.56 $\pm$ 0.57	8459 $\pm$ 2452	5133 $\pm$ 1531
36-49 y.o.	8.14 $\pm$ 1.20	2.66 $\pm$ 0.29	2.61 $\pm$ 0.79	1.80 $\pm$ 0.58	9843 $\pm$ 3295	6121 $\pm$ 2271
> 49 y.o.	7.68 $\pm$ 1.35	2.70 $\pm$ 0.28	2.39 $\pm$ 0.87	1.67 $\pm$ 0.63	9750 $\pm$ 3697	6027 $\pm$ 1962

\* Score index;# hours/day, & counts/day

Investigating the association between absenteeism, work performance (both gathered by questionnaires), physical activity and sedentary behaviour (gathered by accelerometer), indicated that a person who spent more steps a day, and accumulated more MVPA presented higher habitual physical activity index (Figure 3), in contrast those who presented more time accumulated in sitting and sedentary activity (Figure 4).

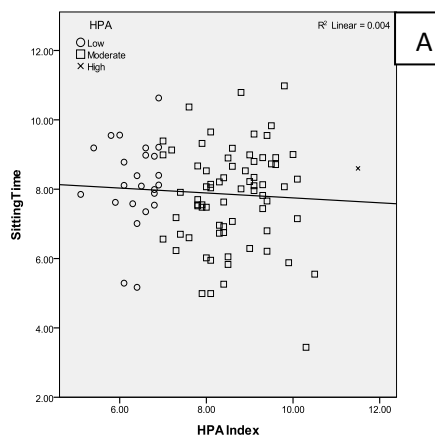


$$R^2 = 0.059$$

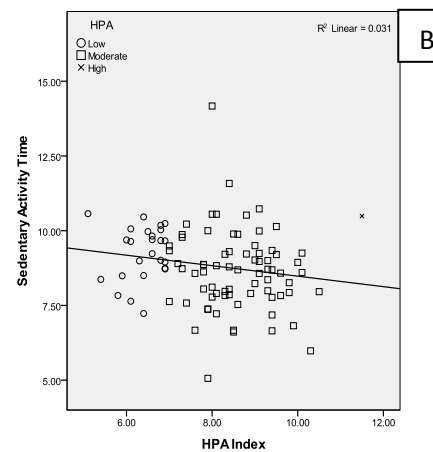


$$R^2 = 0.050$$

Figure 3: HPA Index and active behaviour relationship, according step count (A) and MVPA time (B)



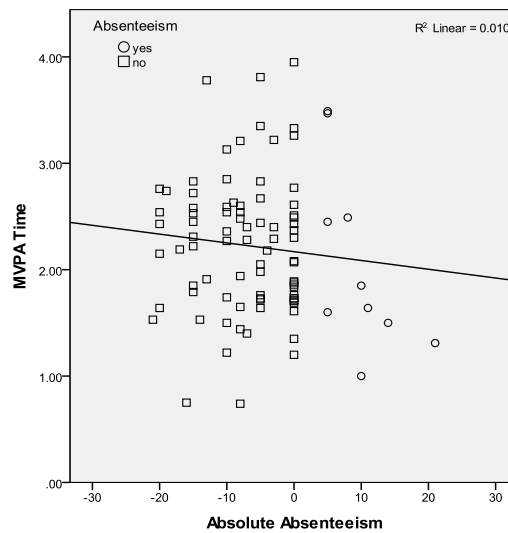
$$R^2 = 0.004$$



$$R^2 = 0.031$$

Figure 4: HPA Index and sedentary behaviour relationship, according to sitting time (A) and sedentary activity time (B)

Teachers who accumulated higher MVPA time showed low levels of absolute absenteeism (Figure 5). For work performance, no significant association was found with physical activity and sedentary behaviour.



*Negative values mean lower levels of absenteeism*

$$R^2 = 0.010$$

Figure 5: Absenteeism and active behaviour relationship

Measured through self-reports, teachers are recognised as moderately active in all areas assessed (work, sport, and leisure time).

In summary, teachers showed low levels of absenteeism and high levels of presenteeism. There were no significant differences by gender, but the oldest teachers showed significantly higher levels of work performance than their youngest counterpart.

A significant relationship between physical activity, sedentary behaviour and productivity was not found.

#### 5.4. Teachers' and children's physical activity and sedentary behaviour patterns at school.

This section reports on children's physical activity and sedentary behaviour profiles, during school time and the whole day. The report begins with a general description, followed by sedentary and physical activity data patterns and trends throughout the school week. This is followed by, a comparison of teachers' and children's physical activity and sedentary patterns at school.

Participants were children enrolled at public and integrated schools in the Auckland Metropolitan Area aged 5 and 11 years (years 0 – 6) with an average of  $7.9 \pm 1.8$  years (from 5 to 11 years old) ranging from the year 0 to the year 6. The participating schools were divided into high and low decile groups (see Table 26).

Table 26: Children's demographic data

	N	Male	Female	Decile	
				Low	High
Gender	131	62	69	47	84
Age (years)	129				
	5	13	9	4	9
	6	19	11	8	11
	7	22	11	4	18
	8	24	11	11	13
	9	24	12	7	17
	10	16	3	8	8
	11	11	4	5	6
School grade	129				
	NE	2	1	2	0
	1	22	14	8	14
	2	24	14	6	18
	3	22	10	7	15
	4	23	12	9	14
	5	18	4	7	11
	6	18	6	8	10

NE: New Entrants



### *Children's physical and sedentary behaviour activity levels*

To determine the children's physical activity and sedentary behaviour profile, measurement of five consecutive days of activity during a normal school week was undertaken. Three full school days of data were used for data analysis (Tuesday to Thursday).

The children's sedentary behaviour pattern showed (Table 27) that they spent on average 48% of their waking time at-school during which most of their time was spent sitting (59%). During out-of-school hours, children were seated for 61% of the time.

Children were significantly ( $p<0.01$ ) more sedentary out-of-school (56% of the time) in comparison with at-school (44%).

In our sample of children 100% meet the physical activity recommendation of greater than 60 min of moderate to vigorous activity per day. The 60 min was achieved on each of the three school days. The moderate intensity activity was calculated in 1 min bouts.

Table 27: Children's active and sedentary behaviours during school and out-of-school hours

	Total				At-school				Out-of-school				<i>p</i> value***
	N	Mean	SD	Median	Mean	SD	Median	%	Mean	SD	Median	%	
Awake(h/d)	131	12.35	0.88	12.26	5.98	0.08	6.00	48	6.37	0.87	7.17	52	0.001
Sitting time**(h/d)	130	7.41	1.44	7.53	3.53	0.71	3.54	48	3.88	1.04	3.96	52	0.001
Standing time**(h/d)	130	2.99	0.96	2.95	1.46	0.54	1.38	49	1.52	0.57	1.86	51	0.202
Sedentary time*(h/d)	129	5.55	1.13	5.53	2.49	0.54	2.49	45	3.06	0.83	3.83	55	0.001
Steps count*	131	10724	2932	10015	5759	1780	5439	54	4965	1724	5526	46	0.001
Stepping time**(h/d)	130	1.83	0.49	1.83	0.98	0.29	1.00	54	0.85	0.31	1.05	46	0.001
Transitions count**	130	88	19	88	49	12	49	56	39	12	48	44	0.001
Light activity time*(h/d)	129	4.19	0.70	4.16	2.11	0.38	2.14	50	2.08	0.53	2.60	50	0.555
MVPA time*(h/d)	129	2.48	0.62	2.45	1.38	0.33	1.38	56	1.14	0.39	1.35	44	0.000

Assessed by: \*ActiCal, \*\*activPAL :

*p* value\*\*\* at-school and out-of-school comparisons

Table 27, which report the children's physical activity levels, categorised according to intensity, shows that the children spent a similar amount of time in light physical activity at-school and out-of-school (50%).

Children were more active at-school than out-of-school ( $p < 0.01$ ), performing more steps (966 steps/h at-school versus 779 steps/h out-of-school (see Table 23)). On average, interruptions in sitting time was significantly higher ( $p < 0.0001$ ) during school time (49 times/d) than out-of-school (39 times/d).

The physical activity levels of children (Table 27) indicated that they spent 20% of their waking hours performing MVPA, most of it at school. Light intensity activities constituted a greater percentage (34%) of active behaviour during waking hours. Children from the lower decile schools showed a slightly more active pattern at school (58%) than their counterparts from higher decile schools (57%), walking similarly (54%

and 54%, respectively), and spending more time in MVPA (55% and 54%). Similar patterns were shown in out-of-school time, the children from lower decile schools walking 46% of their time as did the children from the high decile schools. The time spent in MVPA was 45% and 46% respectively. Transitions from sitting to standing at school were performed one every 7.5 minutes (eight times/hour) by the children from both lower and higher decile schools. In general children were active the majority of the time (53% of their waking time), and accumulated enough MVPA (168 min/day).

#### *Children's physical activity and sedentary behaviour: day-by-day trend*

Children's physical activity and sedentary behaviour levels were consistent between days ( $p>0.05$ ). An average of 29% of total awake time was spent sitting at school, 12% was spent standing at school, and 20% was spent in sedentary activities at school. The trend of physical activity level was similar, accumulating in stepping at school an average of 8% of the total awaking time, 17% in light intensity activities, and 11% in the MVPA.

#### *Teachers' and children's physical activity and sedentary behaviour comparison*

In order to compare teachers' and children's physical activity and sedentary behaviour patterns, data were adjusted to the teaching time (9:00 am to 3:00 pm) for 63 pairs of data (63 teachers, 132 children).

Teachers spent more time standing than children (2.61 h/d;  $p=0.001$ ). Children performed on average more transitions than teachers in a typical school day. Teachers

spent less time moving than children during school time ( $p=0.001$ ). Time spent in MVPA by teachers was less than children (see Table 28).

Table 28: Physical activity and sedentary behaviour, adjusted values from 9:00 am to 3:00 pm for teachers and children

Time at school	Teachers			Children			$r^{\#}$	$p$
	Mean	SD	%	Mean	SD	%		
Sitting time	3.21	0.64	53.5	3.53	0.71	58.8	0.30	0.020*
Standing time	2.69	0.61	44.8	1.46	0.54	24.3	0.10	0.459
Stepping time	0.74	0.22	12.3	0.98	0.29	16.3	0.16	0.221
Transitions count	29.81	9.13		49	12		0.10	0.428
Step count	3607	1085		5759	1780		0.15	0.230
Sedentary activity time	3.22	0.61	53.7	2.49	0.54	41.5	0.21	0.106
Light activity time	1.77	0.36	29.5	2.11	0.38	35.2	0.22	0.081
MVPA time	0.99	0.35	16.5	1.38	0.33	23.0	0.26	0.040*

\*Significant at  $\alpha < 0.05$

# Correlation coefficient

% of the total time during class time

Children's behaviour generally mirrored that of their teachers. For instance, children whose teachers accumulated more sitting time at school exhibited a similar pattern of sedentary behaviour. Likewise, children whose teachers accumulated less sitting time at-school exhibited a similar physical behaviour pattern (Table 29).

Table 29: Teachers' and children's sitting and MVPA time comparison

		Children	
		Low	High
Teachers	Sitting time		
	Low	29%	21%
	High	21%	29%
	MVPA time		
	Low	33%	19%
	High	19%	29%

There were no significant differences in behaviour observed between children and teachers from lower or higher decile schools. The socioeconomic status of the school did not significantly affect the participants' physical activity and sedentary behaviour levels.

In summary, children participating in this study met the physical activity recommendations of accumulating at least 60 minutes per day of MVPA. These children were more active while at school, as well as their teachers.

Children showed a trend of physical activity and sedentary behaviour levels similar to their teachers. Those children whose teachers accumulated more physical activity time at school were more active in comparison with children who spent more time with less physically active teachers.

## CHAPTER 6: Discussion and conclusion

### 6.1. Overview

Non-communicable diseases remain the largest cause of death (W.H.O., 2004). In New Zealand, four out of ten deaths are caused by cardiovascular diseases (Ministry of Health, 2003). There are many factors that increase the risk of cardiovascular disease (environment, genetic, behaviours, etc.). Physical inactivity increases the probability of deterring health (Hamilton et al., 2008), and sedentary occupations exacerbate this condition. Physical inactivity is pandemic, a leading cause of death in the world (Kohl et al., 2012). People in different professions exhibit different health behaviours, because of either occupational requirements or personal choices.

On average, the working population, including teachers, spends around one third of the day at work (Smith et al., 1999). There is growing evidence about the association between sedentary behaviour at the workplace, absenteeism and chronic disease (Chan et al., 2004; Hamilton et al., 2007; Murphy et al., 2006). Previous studies suggest that interrupting sitting time could reduce both absenteeism and chronic diseases (Beers et al., 2008; Healy et al., 2008; McAlpine et al., 2007). To date, there has been little investigation into primary school teachers' health behaviours, and the effect these behaviours could have on the academic results of their students. This piece of work is the first Australasian study focusing, on teachers' physical activity and sedentary behaviour and their cardiovascular health status as well as the relationship between teachers' physical activity and sedentary behaviour and that of their students. These findings provide some initial evidence for public health policy makers to consider when

making school-based policy interventions to promote physical activity not only for teachers but also for children.

The aim of this thesis was to determine how the work environment affects physical activity and sedentary behaviour and health in primary school teachers in New Zealand. The study attempted to identify aspects that facilitate or prevent teachers involvement in physical activity at work was the first component of the thesis. As cardiovascular health is influenced by physical and sedentary activity, these behaviours were investigated to quantify the amount of time teachers spending these behaviours while at-work and out-of-work. Additionally, teachers' and children's physical activity and sedentary behaviour were compared to determine if there was a correlation between them.

#### *Work environment and physical activity*

The school environment influences the lifestyle of all those who are associated with it. Aspects of that environment both favour and hinder certain behaviours associated with physical activity. The results of this study indicate the school is an active working environment, offering numerous opportunities for teachers to move while working. The new curriculum demands, the dimensions of the schools, and the extracurricular activities engaged in by teachers all enable the acquisition and development of active behaviours in teachers. New Zealand school environment could serve as model for other countries to provide school environments that facilitate teachers' occupational physical activity.

However, the study also identified there were some factors that hindered the acquisition and development of these active lifestyles. The primary teachers in this study echoed the cries of the general population (Salmon et al., 2003) that lack of time is the main barrier to engaging in physical activity. When time is at a premium, physical activity is often relegated to make way for other perceived priorities. The participants explained that they spent long hours in work-related activities, both at school and out of school time, and this was reported as a probable cause of discouraging teachers' participation or engage in physical activity (Resnicow et al., 1998). In the general population, the most declared barriers of being involved in physical activity were: lack of self-motivation, bad weather, busy social schedule, busy home or family schedule, busy work schedule (Bowles, Morrow, Leonard, Hawkins, & Couzelis, 2002), not unlike the findings in this study.

Previous studies have shown that in line with the general population, the barriers to teachers engaging in physical activity are lack of interest, other priorities and laziness. In their study, Reichert et al. (Reichert, Barros, Domingues, & Hallal, 2007) reported lack of time, dislike of exercising, feeling too tired, lack of company and lack of money as barriers faced by the general population. A further personal reason identified by the teachers in this study was their lack of training in subjects such as physical education. This lack of training meant they did not feel confident teaching physical education type classes to students.

The teachers' perception about their own workload is different from that reported in the literature, and current demands seemed greater than in the past (LaMaster et al., 1998).



The movement requirements of teachers in junior schools and senior schools differ. In junior school teachers generally move a lot more than their senior school counterparts most likely because of the nature of learning at this early stage. Nurturing and motivating their young charges and generally dealing with young children's active learning needs require primary school teachers to move more. New Zealand literature (Bridges & Searle, 2011) reports that teachers perceived an increase in their workload in the last 10 years, with attendant implications on their well-being, including fewer opportunities to engage in physical activity, increased stress, fatigue and depression.

*Quantifying teachers' physical activity, sedentary behaviour, cardiovascular health, and work productivity*

Data from this thesis showed that primary school teachers spend many hours sitting at work (33%) similar to the finding reported by Smith et al., (Smith et al., 1999). That said, the teachers in this study accumulated the majority of their physical activity at work (2.72 h/d of light activity, and 1.65 h/d of MVPA). Physical activity was higher than the levels recommended for a healthy lifestyle (Pate, 1995) although a 10 minutes bout assessment was not performed. Moreover, in the studied sample, the cardiovascular disease risk was lower (ranging between < 0.5 and 20%) compared with the literature reviewed (> 20% (D'Agostino et al., 2008)). This group is therefore less likely to develop a CVD in the next 10 years.

Teaching is considered to be at the lower end of the spectrum in terms of physically demanding professions (Bergström et al., 1999). The new curriculum demands (Ministry of Education, 2007) have increased the level of burden for teachers and

students, bringing about changes in pedagogical practice. In a sample of teachers from India, (Vaz & Bharathi, 2004) it was found that the teachers' occupational physical activity was around 41% of the total daily energy expenditure, classifying this professional group as moderately physically active. This would seem to suggest that the participants in this study fall into a moderate profile rather than a sedentary one, despite the fact that the teachers' physical activity levels tend to decrease when teachers work in the higher school grades.

This study observed in teachers frequent changes from a sedentary position to an active position while working (around 5 times/h). These transitions showed a protective association on teachers' health parameters. The contribution of interrupting sedentary behaviour, and the balance between active and sedentary behaviours, could be important in determining the percentage of cardiovascular diseases in the studied population, and in confirming the protective value of these activities (Beers et al., 2008; Healy et al., 2008; McAlpine et al., 2007). In addition, data from this study suggest that it is possible to reach the recommended values (45 to 60 min/d) of MVPA to prevent the transition from overweight to obesity (Saris et al., 2003).

In general teachers were sedentary the majority of the time, but nonetheless accumulated enough MVPA (145 min/d) to compensate for this sedentary behaviour. There was an average energy expenditure (EE) of 409 kcal/d, despite the fact that the steps taken by the teachers did not reach recommended levels (Tudor-Locke & Bassett, 2004). The physical activity and sedentary behaviour ratios in this study suggest that primary school teachers were more active during working hours than when they were

out-of-work. This is in contrast with earlier data suggesting that teachers were more active out-of-work (LaMaster et al., 1998). No significant differences were observed to suggest teachers had more or less active days during the week, confirming a clear pattern of behaviour.

The results indicated that sitting increased the development of hypertension and increased the chances of developing a cardiovascular disease by about 2.5 times, similar to the results reported by Hamilton et al. (Hamilton et al., 2008). However, accumulating time in non-sedentary activity, such as standing or walking, as well as interrupting continuous sedentary behaviours, decreased (although not statistically significantly) cardiovascular risk factors between 5% to 65%, concordant with the Healy study (Healy et al., 2008), which found that independent of the time spent in sedentary and moderate-to-vigorous activities, interrupting sedentary time was beneficial to health status.

The cardiovascular risk factor prevalence indicates that obesity was determined as the largest component in this group of workers (17%), well below what was presented in a study of primary school teachers in the USA where obesity prevalence was reported at 42% (Webber et al., 2012).

#### Self reported physical activity and perceived workload and productivity analysis

The perception that teachers had about their workload was assessed using two questionnaires. In the three areas assessed, physical activity was determined as

moderate level of activity, a little bit different from the classification proposed by Bergström et al. (Bergström et al., 1999), who considered teaching as a low demanding physical activity profession.

Younger teachers showed significantly higher levels of physical activity, both at work and in sport, but older teachers exhibited higher levels of leisure time physical activity. As expected, most of the teachers were sitting and/or standing (64%) or walking (61%) while they were at work, consistent with the active teaching model promoted by the New Zealand educational authorities (Ministry of Education, 2007), as well as the current educational trends (Bandura, 1977). These data are contrasted with those reported in a study from Thailand (Chaiklieng & Suggaravetsiri, 2012) where teachers were found to spend 79% of their teaching time in sitting and standing postures, and a study of teachers in the USA (Webber et al., 2012), which reported those teachers engaged in less than 1 min/d of MVPA. New Zealand teachers spend an average of 99 min/d MVPA at-work. The sample of teachers in this study were arguable physically active because 65% of them reported participating in at least one sporting activity per week on a regular basis.

The data revealed that the teachers in this study had high productivity levels (measured by rates of absenteeism and presenteeism), worked for long hours and had low rates of absenteeism compared with others in the same occupation (Table 24). The middle-aged participants, 36 to 49 years, showed the lowest values of absenteeism, compared with the youngest and the oldest teachers. In terms of productivity, participants older than 49 years had significantly better values than younger teachers. Recent studies have shown

that absenteeism correlated negatively with the work and leisure-time physical activity index (Carson et al., 2010). The studied group showed a good level in both indices, which explains their high level of productivity.

Comparing the data obtained objectively (accelerometry) with those reported subjectively (questionnaires) corroborated the teachers' perception that their workload is more moderate than light, and that they are active rather than sedentary subjects. Surprisingly, the oldest and middle-aged teachers showed higher values of MVPA and step count than their younger counterparts.

#### *Teachers' and children's physical activity and sedentary behaviour relationship*

This thesis indicates that there was a trend (though not statistically significant) for children to mimic the behaviour of their teachers; children of sedentary teachers had higher sitting time during the day and children of active teachers showed elevated MVPA time. According to Cardinal and colleagues (Cardinal, 2001), active teachers are more willing to be role models and are more aware about the benefits of regular active behaviour and readily transmit those messages to their children.

Children are expected to be more active than adults. The recommended steps/day for adults is 10,000 in contrast to 12,000 steps/day for children (Tudor-Locke, Johnson, & Katzmarzyk, 2009). In this study, a moderate physical activity level for both teachers and children was observed when compared to the international recommendations for health (W.H.O., 2010), which state that adults must accumulate 150 min/week and children must accumulate 60 min/day of moderate to vigorous physical activity to keep

healthy. Teachers and children in this study accumulated on average more than 55 and 90 min/day respectively while at school, reaching the recommended values.

An interesting aspect regarding active and sedentary behaviours of teachers and children during class time (9 am to 3 pm), was that teachers had higher values of standing time than their children, but children were much more active in general, walking more and accumulating more time in MVPA.

It was observed that younger children were more active and coupled with the current teaching style, teachers were more involved in movement. Moreover, teachers' role modelling appeared as a relevant variable of being active at school for both teachers and children. For teachers, role modelling gave them the opportunity to create new strategies for learning using their awareness of the benefits of physical activity as well as integrating physical activity into their own lives. For children, mimicking active role models may have increased their engagement in physical activity.

The current educational model facilitates a closer relationship between teachers and students requiring greater involvement by teachers in various activities during school time, consistently interrupting their sedentary behaviour and being more active.

## **6.2. Limitations**

While the findings of this thesis provide new data related to the protective value of increasing time in physical activity and reducing time in sedentary behaviour, the

sample size could be considered a limitation. The major limitation of the thesis was that a convenient sample was used because of the difficulty with recruiting teachers already experiencing a high workload at work, which meant that normal assumptions required for using sophisticated statistical modelling were not met. Had we been able to use more advanced modelling the analysis would have allowed for adjustment of clustering in schools, repeated measures, socio-economic status, age and gender.

The sample was comprised mainly of women (88%), a little higher than the New Zealand rate (82%) (Demographic and Statistical Analysis Unit, 2005), and though several of those sampled were considered overweight or obese (17%), the sample was also biased by healthy individuals, with none reporting diabetes and tobacco consumption. The participants' personal attitudes to an active lifestyle made it impossible to know what happens to individuals who have one or more risk factors for health.

All measurements were collected in urban setting in the Auckland Metropolitan Area. It was therefore not possible to know the extent of the occupational physical activity demand in rural environments where distance to work, access to facilities, pollution, quality of life and type of food could be different.

The cost of measuring HDL cholesterol separately in this study was prohibitive. If cost were not an issue actual HDL cholesterol levels could have been entered and the protective effect of high levels of HDL (moderately active group) could have produced an even lower percentage of cardiovascular risk.

Another limitation was the inability to observe behaviours for a longer period, for both teachers and students, due primarily to the limited number of measuring instruments and the limited time available to conduct the research. A longer observation period would have allowed a more in depth analysis of the relationship between the sedentary and active behaviours of the two groups.

### **6.3. Future directions**

To further our knowledge and understanding of teachers' physical activity and sedentary behaviour, and to further develop the findings of this thesis, standards for assessing sedentary behaviour in various social, economic and cultural contexts, from childhood to old age, need to be established.

Since it is known that there are several factors that affect teachers' health and productivity, more studies are needed to investigate ways to increase occupational physical activity and reduce sedentary behaviour to improve health. An opportunity exists to validate a sedentary behaviour questionnaire against the objective measurement.

Furthermore, a more in depth observation about the influences active and sedentary behaviours of teachers have on the active and sedentary behaviours of their students is needed, since this study reported a trend that children exhibit similar behaviours to their teachers. Conducting more sophisticated statistical analysis (linear modelling), account for clustering, adjusting for known confounders, and conducting analysis for 10-min bouts of physical activity also are required.



It was recognised that reducing sedentary behaviours at an early age is a priority, because behaviour patterns developed early on to follow individuals into adulthood. Implementing a comprehensive strategy, involving the whole school community including teachers, should be the focus of future interventions. These interventions should consider both environmental and social aspects as these impact physical activity behaviour.

As practical recommendations, the design of promotion and/or intervention strategies must be comprehensive and multidisciplinary encompassing all aspects that can influence lifestyle. This will increase the likelihood of improving the physical activity habits of the general population.

As teachers identified several facilitators that could allow to be active at school, for both teachers and children, it is possible to recommend actions like changing the classroom layout, changing teaching style, participating in school sport clubs, and using active breaks as a reward for good student behaviours.

In order to reduce cardiovascular risk for this professional group and others similar, increasing the total time of being physically active is needed. As most of the working population spend more than half of their awake time at work, interrupting sedentary behaviours throughout the working day is required, in addition to the current physical activity recommendations.

#### **6.4. Conclusion**

Primary school teachers from the Auckland Metropolitan Area met the recommended levels to be classified as physically active individuals since they met the daily and weekly times involved in MVPA, most of this time being accumulated at work. Furthermore, they demonstrated a low percentage of cardiovascular risk, regardless of whether they taught at a higher or lower decile school.

When considering time spent in sedentary behaviours, teachers were more sedentary out-of-work, and teachers from the lower deciles schools, were more sedentary than their higher decile counterparts. However, there were no significant differences in the means between these two groups.

Based on the evidence from this study, the level of occupational physical activity indicates that the teaching profession could be reclassified as moderately physically demanding, at least with respect to primary school teachers. The study also showed that the more active teachers (most time accumulated MVPA) showed lower rates of absenteeism than those less active.

Regarding the methodology used to assess the level of physical activity, the combination of objective and subjective measures, allowed the generation of more complete and comprehensive information about with the behaviours studied.

Barriers to not engaging in regular physical activity were confirmed, as lack of time and work demands, despite “School” appearing to be an active workplace, offering numerous opportunities to become or stay active. The work environment in New Zealand public primary schools provides a replicable model for other countries in similar settings to facilitate teachers the increase of their occupational physical activity.

Meeting the activity guideline may not guarantee good health if sedentary behaviour is not interrupted throughout the working days. Future research and more evidence to support interrupting sedentary behaviour throughout the working day is required so that it may become an additional health recommendation.

## CHAPTER 7: References

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## APPENDICES

### Appendix 1: Ethical approval by AUTECH



## MEMORANDUM

### Auckland University of Technology Ethics Committee (AUTECH)

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To: Erica Hinckson

From: **Madeline Banda** Executive Secretary, AUTECH

Date: 2 November 2010

Subject: Ethics Application Number 10/220 **Teachers' workplace: physical activity and sedentary behaviour.**

---

Dear Erica

Thank you for providing written evidence as requested. I am pleased to advise that it satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTECH) at their meeting on 13 September 2010 and that I have approved your ethics application. This delegated approval is made in accordance with section 5.3.2.3 of AUTECH's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement at AUTECH's meeting on 13 December 2010.

Your ethics application is approved for a period of three years until 2 November 2013.

I advise that as part of the ethics approval process, you are required to submit the following to AUTECH:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 2 November 2013;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. This report is to be submitted either when the approval expires on 2 November 2013 or on completion of the project, whichever comes sooner;

It is a condition of approval that AUTECH is notified of any adverse events or if the research does not commence. AUTECH approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are reminded that, as applicant, you are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

Please note that AUTECH grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this.

When communicating with us about this application, we ask that you use the application number and study title to enable us to provide you with prompt service. Should you have any further enquiries regarding this matter, you are welcome to contact Charles Grinter, Ethics Coordinator, by email at [ethics@aut.ac.nz](mailto:ethics@aut.ac.nz) or by telephone on 921 9999 at extension 8860.

On behalf of the AUTECH and myself, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely



Madeline Banda

**Executive Secretary**

**Auckland University of Technology Ethics Committee**

Cc: Marcelo Castillo [mcastill@aut.ac.nz](mailto:mcastill@aut.ac.nz)



# MEMORANDUM

## Auckland University of Technology Ethics Committee (AUTEC)

---

To: Erica Hinckson

From: **Madeline Banda** Executive Secretary, AUTEC

Date: 30 November 2010

Subject: Ethics Application Number 10/221 **The effect of interrupting teachers' sedentary behaviour on children's activity levels at school.**

---

Dear Erica

Thank you for providing written evidence as requested. I am pleased to advise that it satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC) at their meeting on 13 September 2010 and that I have approved your ethics application. This delegated approval is made in accordance with section 5.3.2.3 of AUTEC's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement at AUTEC's meeting on 13 December 2010.

Your ethics application is approved for a period of three years until 30 November 2013.

I advise that as part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 30 November 2013;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. This report is to be submitted either when the approval expires on 30 November 2013 or on completion of the project, whichever comes sooner;

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are reminded that, as applicant, you are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

Please note that AUTEK grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this.

When communicating with us about this application, we ask that you use the application number and study title to enable us to provide you with prompt service. Should you have any further enquiries regarding this matter, you are welcome to contact Charles Grinter, Ethics Coordinator, by email at [ethics@aut.ac.nz](mailto:ethics@aut.ac.nz) or by telephone on 921 9999 at extension 8860.

On behalf of the AUTEK and myself, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely

A handwritten signature in black ink, appearing to read 'M. Banda'.

Madeline Banda

**Executive Secretary**

**Auckland University of Technology Ethics Committee**

Cc: Marcelo Castillo [mcastill@aut.ac.nz](mailto:mcastill@aut.ac.nz)

## Appendix 2: Consent forms for schools, teachers and children

# Permission to Access Form



*Project title:* **Teachers' workplace: physical activity and sedentary behaviour**

*Project Supervisors:* **Dr Erica Hinckson**

*Researcher:* **Marcelo Castillo**

- ☐ I have read and understood the information provided about this research project contained in the Information Sheet dated 7 February 2011.
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ All necessary authorisations have been sought and approval granted for this research project to take place at \_\_\_\_\_ School.
- ☐ All signatories are authorised to grant approval for \_\_\_\_\_ School to participate in this research.
- ☐ \_\_\_\_\_ School wishes to receive \_\_\_\_ copies of any report and journal articles submitted for publication as a result of this research.

School Name: .....

School Address:

Street Address: .....

Suburb: .....

City: .....

Principal Signature: .....

Name (print): .....

***Approved by the Auckland University of Technology Ethics Committee on 2 November 2010 AUTEK Reference number 10/220 and on 30 November 2010 AUTEK Reference number 10/221***

*Note: The School Principal should retain a copy of this form.*

# Consent Form



*Project title:* **Teachers' workplace sedentary and physical activity patterns**

*Project Supervisor:* **Dr. Erica Hinckson**

*Researcher:* **Marcelo Castillo**

- ☐ I have read and understood the information provided about this research project in the Information Sheet dated 7 February 2011
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ☐ I understand that I may to complete short questionnaires about physical activity at work
- ☐ I understand that I may wear two motion sensors for one week.
- ☐ I agree to provide blood samples to determine cardiovascular risk.
- ☐ If I withdraw, I understand that all the information provided or/and related with my participation will be destroyed.
- ☐ I agree to take part in this research.
- ☐ I wish to receive a copy of the report from the research (please tick one): Yes ☐ No ☐

Participant's signature: .....

Participant's name: .....

Participant's Contact Details (if appropriate):.....

Date:

***Approved by the Auckland University of Technology Ethics Committee on 2 November 2010 ATEC Reference number ATEC 10/220***

# Parent/Guardian Consent Form



*Project title:*                    ***Relationship between teachers' and children's physical and sedentary activity patterns***

*Project Supervisor:*        **Dr Erica Hinckson**

*Researcher:*                    **Marcelo Castillo**

- ☐ I have read and understood the information provided about this research project in the Information Sheet dated 7 February 2011
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that the researchers will compare sedentary and physical activities by collecting from the motion sensors (ActivPAL monitor, ActiCal accelerometer) with their teachers.
- ☐ I understand that I may withdraw my child and/or myself or any information that we have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ☐ If my child and/or I withdraw, I understand that all relevant information will be destroyed.
- ☐ I agree to my child taking part in this research.
- ☐ I wish to receive a copy of the report from the research (please tick one): Yes ☐ No ☐

Child's name : .....

Parent/Guardian's signature: .....

Parent/Guardian's name: .....

Parent/Guardian's Contact Details (if appropriate):.....

Date:

***Approved by the Auckland University of Technology Ethics Committee on 30 November 2010 AUTECH Reference number 10/221***



# Assent Form



*Project title:*                    ***Relationship between teachers' and children's physical and sedentary activity patterns***

*Project Supervisor:*    **Dr Erica Hinckson**

*Researcher:*                    **Marcelo Castillo**

- ☐ I have read and understood the sheet telling me what will happen in this study and why it is important.
- ☐ I have been able to ask questions and to have them answered.
- ☐ I understand that data will be collected by motion sensors (small computers) attached to the child waistline and thigh.
- ☐ I understand that while the information is being collected, I can stop being part of this study whenever I want and that it is perfectly ok for me to do this.
- ☐ If I stop being part of the study, I understand that all information about me will be destroyed.
- ☐ I agree to take part in this research.

Participant's signature: .....

Participant's name: .....

Participant Contact Details (if appropriate):

.....

Date:

***Approved by the Auckland University of Technology Ethics Committee on 30 November 2010 ATEC Reference number 10/221***

### Appendix 3: Teachers' and children's log sheets

#### Teachers' workplace: physical activity and sedentary behaviour study

Participant CODE

Start Date  Start Time

Please complete the log below for the next five days starting from today

Finish Date  Finish Time

Please circle any day when you <u>did not</u> wear the devices	Monday	Tuesday	Wednesday	Thursday	Friday
For each day, record the times the devices were <u>not</u> worn (e.g. 1:00 pm - 2:00 pm)					
For each day, record the activity you did when you were <u>not</u> wearing the devices					
For each day, record the unusual activity that you did at school (e.g. Athletic day, sport day, outdoor week, school trip, others) as part of your duties.					
For each day, record the time spent in the unusual activities performed (e.g. 9:00 am to 10:00 am)					
For each day, record the time you woke up?					
For each day, record the time you went to bed?					
For each day, record the time that you start working at school.					
For each day, record the time that you finish working at school.					

activPALS/N:

ActualS/N:

# Relation between teachers' children's physical and sedentary activity patterns Study


Participant CODE  Start Date  Start Time

Please complete the log below for the next five days starting from today Finish Time

Please circle any day when you <u>did not</u> wear the devices	Monday	Tuesday	Wednesday	Thursday	Friday
For each day, record the times the devices were <u>not</u> worn (e.g. 1:00 pm - 2:00 pm).					
For each day, record the activity you did when you were <u>not</u> wearing the devices.					
For each day, record the unusual activity that you did at school (e.g. Athletics day, sport day, camp, outdoor week, school trip, others).					
For each day, record the time spent in the unusual activities (e.g. 9:00 am to 10:00 am).					
For each day, record the time you woke up.					
For each day, record the time you went to bed.					
For each day, record the after school activity you did.					
For each day, record the time spent in after school activity?					

actvPAL S/N: Actual s/n: D.O.B.  Ethnicity  Year:  Classroom:

## Appendix 4: QHPA and HPQ questionnaires

<b><u>MEASUREMENT OF HABITUAL PHYSICAL ACTIVITY</u></b> <b><u>QUESTIONNAIRE</u></b>	
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This is an internationally approved questionnaire. Please ignore any questions that you think are not relevant.

### Section 1: Work Activity

1. What is your main occupation? \_\_\_\_\_

2. At work I sit      Never ☐      seldom ☐      sometimes ☐      often ☐      always ☐

3. At work I stand      Never ☐      seldom ☐      sometimes ☐      often ☐      always ☐

4. At work I walk      Never ☐      seldom ☐      sometimes ☐      often ☐      always ☐

5. At work I lift heavy loads

Never ☐      seldom ☐      sometimes ☐      often ☐      always ☐

6. After working I am tired

Never ☐      seldom ☐      sometimes ☐      often ☐      always ☐

7. At work I sweat      Never ☐      seldom ☐      sometimes ☐      often ☐      always ☐

8. In comparison of others of my own age I think my work is physically

Much heavier ☐      heavier ☐      as heavy ☐      lighter ☐      much lighter ☐

Participant Code: \_\_\_\_\_

Date: \_\_\_\_\_

## Section 2: Sports Activity

9. Do you play sports? \_\_\_\_\_

10. In comparison with others of my own age I think my physical activity during leisure time is

Much more ☐ more ☐ the same ☐ less ☐ much less ☐

11. During leisure time I sweat

Very often ☐ often ☐ sometimes ☐ seldom ☐ never ☐

12. During leisure time I play sports

Very often ☐ often ☐ sometimes ☐ seldom ☐ never ☐

13. What sport do you play most frequently? \_\_\_\_\_

14. How many hours do you play a week?

< 1 hour ☐ 1-2 hours ☐ 2-3 hours ☐ 3-4 hours ☐ > 4 hours ☐

15. How many months do you play in a year?

< 1 month ☐ 1-3 months ☐ 4-6 months ☐ 7-9 months ☐ > 9 months ☐

16. What sport do you play second most frequently? \_\_\_\_\_

17. How many hours do you play a week?

< 1 hour ☐ 1-2 hours ☐ 2-3 hours ☐ 3-4 hours ☐ > 4 hours ☐

18. How many months do you play in a year?

< 1 month ☐ 1-3 months ☐ 4-6 months ☐ 7-9 months ☐ > 9 months ☐

Participant Code: \_\_\_\_\_

Date: \_\_\_\_\_

### Section 3: Leisure Activity

19. During leisure time I watch television

Very often ☐ often ☐ sometimes ☐ seldom ☐ never ☐

20. During leisure time I walk

Very often ☐ often ☐ sometimes ☐ seldom ☐ never ☐

21. During leisure time I cycle

Very often ☐ often ☐ sometimes ☐ seldom ☐ never ☐

22. How many minutes do you walk and/or cycle per day to and from work, school and shopping?

< 5 min ☐ 5-15 min ☐ 15-30 min ☐ 30-45 min ☐ >45 min ☐

Thanks

Participant Code: \_\_\_\_\_

Date: \_\_\_\_\_

**World Health Organization and Performance**  
**Questionnaire (HPQ)**

This is an internationally approved questionnaire. Please ignore any questions that you think are not relevant.

Participant Code: ALT11W

Date: \_\_\_\_\_

## A. YOUR WORK

**A1. Are you currently in any of the following work situations? For each "Yes" response, record how long you have been in this situation (for example, 3 weeks or 5 months or 7 years).**

	How long have you been in this situation?					
	Yes	No	<i>Enter Number</i>	<i>(Circle only one)</i>		
				Weeks	Months	Years
a. Unemployed and looking for work?..	1	2		1	2	3
b. Temporarily laid off?.....	1	2		1	2	3
c. Maternity leave?.....	1	2		1	2	3
d. Short-term sick leave?.....	1	2		1	2	3
e. Extended sick leave or disability?.....	1	2		1	2	3
f. Retired?.....	1	2		1	2	3

**A2. Do you do any of the following kinds of work? For each "Yes" response, estimate the number of hours you typically spend doing this kind of work each week. If it varies, estimate the average.**

	Yes	No	Average Number of Hours each Week
a. Caregiver for your child(ren)?.....	1	2	
b. Working a full-time paying job?.....	1	2	
c. Working a part-time paying job?.....	1	2	
d. Self-employed?.....	1	2	
e. Volunteer work?.....	1	2	
f. Full-time student?.....	1	2	
g. Part-time student?.....	1	2	
h. Housework/home maintenance?.....	1	2	



A3. If you currently work for pay or profit or are on sick leave, please choose the category that best describes your main job. If none of the categories fits you exactly, please respond with the closest category. If you are currently not working and not on sick leave, skip to question B1. (Circle only one number.)

1. Executive, administrator, or senior manager  
(e.g., CEO, sales VP, plant manager)
2. Professional  
(e.g., engineer, accountant, systems analyst)
3. Technical support  
(e.g., lab technician, legal assistant, computer programmer)
4. Sales  
(e.g., sales representative, stockbroker, retail sales)
5. Clerical and administrative support  
(e.g., secretary, billing clerk, office supervisor)
6. Service occupation  
(e.g., security officer, food service worker, janitor)
7. Precision production and crafts worker  
(e.g., mechanic, carpenter, machinist)
8. Operator or laborer  
(e.g., assembly line worker, truck driver, construction worker)

A4. How many people do you personally supervise on your main job?

\_\_\_\_\_ NUMBER OF PEOPLE

- A5. How many hours does your employer expect you to work in a typical 7-day week? If it varies, estimate the average. If you are self-employed, estimate the number of hours you would consider a full work week. If you have more than one job, combine total number of hours for all jobs.

\_\_\_\_\_ NUMBER OF HOURS

- A6. Now please think of your work experiences over the past 7 days. In the spaces provided below, write the number of days you spent in each of the following work situations.

In the past 7 days, how many days did you...

NUMBER  
OF DAYS

- a. ...miss an entire work day because of problems with your physical or mental health? \_\_\_\_\_
- b. ...miss an entire work day for any other reason (including vacation)? \_\_\_\_\_
- c. ...miss part of a work day because of problems with your physical or mental health? \_\_\_\_\_
- d. ...miss part of a work day for any other reason (including vacation)? \_\_\_\_\_
- e. ...come in early, go home late, or work on your day off? \_\_\_\_\_

- A7. About how many hours altogether did you work in the past 7 days? (See examples below.) If you have more than one job, report the combined total number of hours for all jobs. If you did not work at all in the past 7 days, enter "0" and skip to question B1.

\_\_\_\_\_ NUMBER OF HOURS

**Examples for Calculating Hours Worked in the Past 7 Days**

8 hours per day for 5 days = 40 hours

7 hours per day for 5 days = 35 hours

8 hours per day for 4 days plus 4 hours per day for 1 day = 36 hours

7 hours per day for 3 days plus 4 hours per day for 2 days = 29 hours

**A8. Did you have any of the following experiences at work in the past 7 days?**

	<u>Yes</u>	<u>No</u>
a. Any special work success or achievement?.....	1	2
b. Any special work failure?.....	1	2
c. An accident that caused either damage, work delay, a near miss, or a safety risk?....	1	2
d. If you answered "Yes" to any of the questions A8a, A8b, or A8c, please describe what happened.		

**A9. The next questions are about the time you spent during your hours at work in the past 7 days. Circle the one number from each question that comes closest to your experience.**

	<u>All of the time</u>	<u>Most of the time</u>	<u>Some of the time</u>	<u>A little of the time</u>	<u>None of the time</u>
a. How often was your performance <b>higher</b> than most workers on your job?.....	1	2	3	4	5
b. How often was your performance <b>lower</b> than most workers on your job?.....	1	2	3	4	5
c. How often did you do no work at times when you were supposed to be working?..	1	2	3	4	5
d. How often did you find yourself not working as <b>carefully</b> as you should?.....	1	2	3	4	5
e. How often was the <b>quality</b> of your work lower than it should have been?.....	1	2	3	4	5
f. How often did you not concentrate enough on your work?.....	1	2	3	4	5
g. How often did health problems limit the kind or amount of work you could do?.....	1	2	3	4	5

- 

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- Worst Performance 0 1 2 3 4 5 6 7 8 9 10 Top Performance

A13. How would you compare your overall job performance on the days you worked during the past 7 days with the performance of most other workers who have a similar type of job? *(Circle the number)*

1. You were a lot better than other workers
2. You were somewhat better than other workers
3. You were a little better than other workers
4. You were about average
5. You were a little worse than other workers
6. You were somewhat worse than other workers
7. You were a lot worse than other workers

**B. DEMOGRAPHICS**

**B1. How old are you?**

\_\_\_\_\_ Years Old

**B2. Are you male or female? (Circle the letter)**

- a. Male
- b. Female

**B3. What is your current marital status?**

- a. Married or cohabiting
- b. Separated
- c. Divorced
- d. Widowed
- e. Never married

**B4. How many children do you have?**

- a. None
- b. One
- c. Two
- d. Three
- e. Four or more

**B5. What is the highest grade or level of school that you have completed? (Circle the letter)**

- a. 8th grade or less
- b. Some high school, but did not graduate
- c. High school graduate or GED
- d. Some college or 2-year degree
- e. 4-year college graduate
- f. More than 4-year college degree

**B6. What is your height? (Please record both feet and inches.)**

\_\_\_\_\_ Feet \_\_\_\_\_ Inches

**B7. How much do you weigh?**

\_\_\_\_\_ Pounds

**B8. What is your annual income-from your job, before taxes? (Circle the letter)**

- |                        |                        |                           |
|------------------------|------------------------|---------------------------|
| a. \$1 - \$999         | l. \$11,000 - \$11,999 | w. \$30,000 - \$34,999    |
| b. \$1,000 - \$1,999   | m. \$12,000 - \$12,999 | x. \$35,000 - \$39,999    |
| c. \$2,000 - \$2,999   | n. \$13,000 - \$13,999 | y. \$40,000 - \$44,999    |
| d. \$3,000 - \$3,999   | o. \$14,000 - \$14,999 | z. \$45,000 - \$49,999    |
| e. \$4,000 - \$4,999   | p. \$15,000 - \$15,999 | aa. \$50,000 - \$74,999   |
| f. \$5,000 - \$5,999   | q. \$16,000 - \$16,999 | bb. \$75,000 - \$99,999   |
| g. \$6,000 - \$6,999   | r. \$17,000 - \$17,999 | cc. \$100,000 - \$149,999 |
| h. \$7,000 - \$7,999   | s. \$18,000 - \$18,999 | dd. \$150,000 - \$199,999 |
| i. \$8,000 - \$8,999   | t. \$19,000 - \$19,999 | ee. \$200,000 - \$299,999 |
| j. \$9,000 - \$9,999   | u. \$20,000 - \$24,999 | ff. \$300,000 - \$499,999 |
| k. \$10,000 - \$10,999 | v. \$25,000 - \$29,999 | gg. \$500,000 - \$999,999 |
|                        |                        | hh. \$1,000,000 or more   |

## **Appendix 5: Interview questions**

### **IDENTIFYING MEDIATORS AND MODERATORS OF TEACHERS' PHYSICAL ACTIVITY AT SCHOOL**

#### Principals' Interview questions

1. What is the school policy on Physical Activity and how does it relate to the new Physical Activity curriculum?
2. Have you had any difficulty implementing the new Physical Activity curriculum? Have you been able to solve these difficulties? Please explain.
3. How would you classify teachers' physical requirements at work? Why?
4. Understanding physical activity as any bodily movement by muscles, What are the barriers to physical activity for teachers while at school?
5. Can you identify any facilitators to physical activity for teachers while they are at school?
6. In which way do you think teachers can be more active at work?
7. Do you think is a good idea encouraging teachers to be active at work? What sort of physical activity do you think is suitable to include while working or staying at school?

*Approved by the Auckland University of Technology Ethics Committee on 2 November 2010 AUTEK Reference number 10/220*



## **IDENTIFYING MEDIATORS AND MODERATORS OF TEACHERS' PHYSICAL ACTIVITY AT SCHOOL**

### Teachers' Interview questions

1. Could you describe a normal day in this school for teachers and for children? Start and finish time, breaks, and events. Do you have Free Time at School during the week?
2. What do you do during breaks?
3. Do children have chances to interact with you out of the class time? Give examples.
4. Is children's play time supervised? By who? For how long? Every day?
5. Are organized activities and loose equipment offered during children's play time? How often? What kind? For how long?
6. How would you classify your work in terms of physical requirements? Why?
7. If we understand physical activity as any bodily movement produced by muscles, what are the barriers to physical activity for teachers while at school?
8. Can you identify any facilitators to physical activity for teachers while they are at school?
9. In which way do you think your work can be more active?
10. Are you willing to include some physical activity while working or staying at school? What sort of physical activity do you think is suitable to include while working or staying at school?

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**Appendix 6: Sample size estimation**, extracted from Hopkins' spreadsheet (Hopkins, 2006)

**Differences in means in a cross-sectional study**

Smallest difference		Between-subject SD	Proportion in Group A (%)	Maximum rates of statistical errors (%)		Sample size		
				Type I	Type II	Total	Group A	Group B
1000		1700	50	<b>5</b>	<b>20</b>	<b>93</b>	46	46
				very unlikely	unlikely			

**Outcomes in a subsequent study**

Choose an observed change	95 % conf. limits		
	lower	upper	"±"
<b>701.43</b>	0.00	1402.87	701.43