

Toward a Framework for Positive Health

Kathleen Prendergast

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Primary Supervisor: Professor Grant Schofield

Secondary Supervisor: Dr Lisa Mackay

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List of abbreviations

Abbreviation	Definition
AUTEC	Auckland University of Technology Ethics Committee
BDNF	Brain derived neurotrophic factor
BMI	Body mass index
IGF-1	Insulin like growth factor-1
ROS	Reactive oxygen species

Nomenclature

Term/Symbol	Definition
CI	Confidence interval
kg	kilogram
n	Number of cases in a subsample
N	Total number of cases
O/E	Observed/expected, clustering ratio
OR	Odds ratio
%	Percentage
p	p -value, statistical significance
r	Pearson product-moment correlation

List of publications arising from doctoral thesis

Peer-reviewed journal publications

Papers published

Prendergast, K. B., Schofield, G.M., & Mackay, L.M., Associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults. BMC Public Health. 10.1186/s12889-016-2755-0 (Appendix A)

Prendergast, K. B., Mackay, L.M., & Schofield, G.M. The clustering of lifestyle behaviours in New Zealand and their relationship with optimal wellbeing. International Journal of Behavioral Medicine. 10.1007/s12529-016-9552-0 (Appendix B)

Papers in preparation for submission

Prendergast, K. B., Mackay, L.M., & Schofield, G.M. (in preparation for submission) A formative study of public perceptions of nutrition, physical activity, and sleep guidelines and messages

Prendergast, K. B., Schofield, G.M., & Mackay, L.M. (in preparation for submission) What can we learn about lifestyle behaviour change messages from popular books and podcasts?

Prendergast, K. B., Mackay, L.M., & Schofield, G.M. (in preparation for submission). Development and utility of BE Well: A tool to assess satisfaction with positive health behaviours.

Prendergast, K. B., Mackay, L.M., & Schofield, G.M. (in preparation for submission). The acceptability, feasibility, and lessons learned from implementing a positive health intervention.

Peer-reviewed conference presentations

White, K., Mackay, L., Williden, M., McPhee, J., Jarden, A., Schofield, G. (2013). *New Zealanders wellbeing: Does physical activity and nutrition play a part?* Paper presented at the 2013 Agencies for Nutrition Action: It starts with us, Rotorua, New Zealand.

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.

Chapters 3–8 have been submitted (or are in the process of being prepared for submission) for consideration as separate papers for publication in international peer-reviewed journals. The candidate was the main contributor and principal author for each of these papers. All co-authors have approved the inclusion of the papers they were involved in as chapters for this thesis. Individual contributions for these chapters are outlined in the introduction (Chapter 1).

A handwritten signature in black ink, reading "K. Prendergast", is positioned above a horizontal line. The signature is written in a cursive style with a prominent initial "K".

April 2016

Ethical approval

Auckland University of Technology Ethics Committee granted ethical approval for research in the following chapters:

Chapters 3 and 4: AUTECH 12/201, 23 August 2012 (Appendix C)

Chapter 5: AUTECH 14/294, 19 September 2014 (Appendix D)

Chapters 7 and 8: AUTECH 15/263, 25 August 2015 (Appendix E)

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Thesis abstract

Despite explicit reference to promoting health and wellbeing in policy, application and promotion of positive health is limited. In New Zealand, like most societies, the dominant and funded health system is deficit-based. Two disciplines that can contribute toward changing this are positive psychology and public health. From positive psychology, robust articulations of optimal wellbeing (or flourishing) have emerged and the importance of translating and promoting wellbeing is recognised. However, lifestyle behaviours have received little attention. Conversely, lifestyle behaviours are promoted in public health, but primarily to reduce health risk. To address a disconnect between positive health policy and deficit-based practice, positive psychology and public health are integrated in this thesis. The overarching thesis aim is to explore an approach for reorienting toward a framework for positive health. Biological plausibility, epidemiological evidence, and translational research are explored in this doctoral research.

A review of the literature indicates the link between lifestyle behaviours and optimal wellbeing is biologically plausible. However, epidemiological research investigating associations between lifestyle behaviours and emerging measures of optimal wellbeing are limited. To address this gap, associations between lifestyle behaviours and optimal wellbeing are explored in a large, diverse sample of New Zealand adults ($N=9,514$). The findings show that compared with reference groups, higher levels of exercise (odds ratio: 1.61, 95% confidence interval: 1.22-2.13, $p<0.01$) and lower levels of sitting (OR 1.87, 1.01-3.29, $p<0.01$) were associated with an increased likelihood of achieving optimal wellbeing. Conversely, restless sleep (OR 0.24, 95% CI: 0.17-0.32 $p<0.01$) and consuming sugar drinks 5-6 times/week (OR 0.73, 95% CI: 0.53-0.95, $p<0.05$) were associated with a decreased likelihood of achieving optimal wellbeing.

Extending these findings and using a novel combination of behaviours—sleep, physical activity, sedentary behaviour, sugar intake, and fruit and vegetable intake—the clustering of healthy (e.g., meets recommendations) and unhealthy (e.g., does not meet recommendations) dichotomies is explored ($N=9,425$). Outcomes show the five behaviours cluster (healthy: observed/expected 2.0, CI 1.8-2.2; unhealthy: O/E 2.1, CI 1.9-2.3); 5% of the sample endorse all five healthy behaviours; and endorsing 4-5 healthy behaviours is associated with increased

odds of optimal wellbeing (OR 4.7, CI 3.8-5.7). These initial studies make a novel contribution to international wellbeing epidemiology and the findings provide the rationale for targeting lifestyle behaviours, concurrently, in a positive health intervention.

The ensuing work focuses on translation of positive health into practice. The second series of studies employ formative research methods to develop in-depth insights of lifestyle behaviour messaging to laypersons' in a framework for positive health. Qualitative focus groups are used to document, for the first time in New Zealand, laypersons' perceptions of nutrition, physical activity, and sleep guidelines ($N=16$). Findings indicate preference for focusing on the concomitant role of the lifestyle behaviours, benefits beyond weight loss, less prescriptive physical activity and sleep messages, and individual variation.

In the second formative study, adoption of a novel approach provides broader insights into lifestyle behaviour change messages that laypersons' might find appealing. The content and combinations of lifestyle and wellbeing behaviours promoted in popular lifestyle books (Amazon) and podcasts (iTunes) are systematically reviewed. This innovative approach was chosen as, similar to lifestyle behaviour interventions, the success of popular books and podcasts depends on their ability to engage laypersons. Outcomes from this study show nutrition, exercise, and sleep were promoted concurrently in 33% of books ($N=21$) and in 37% of podcasts ($N=35$). In addition, a further 33% of books and 26% of podcasts endorsed these three lifestyle behaviours and wellbeing, concurrently.

Contrasting the emerging trend in popular books and podcasts, there is a paucity of public health initiatives integrating wellbeing and lifestyle behaviours to promote positive health. Based on the convergence of findings from the previous studies, the final series of studies explores the implementation of positive health. A novel audit tool (BE Well) comprising 21 wellbeing and lifestyle behaviours is developed and tested. The Be Well tool enables satisfaction across concurrent behaviours to be quickly assessed, making it ideal for identifying the most pertinent behaviours to target in a positive health intervention. Testing the utility of BE Well shows participants ($N=27$) were least satisfied with their consumption of sugar and processed food (89%), screen-time (85%), time spent outdoors (85%), and exercise (81%). However, test-retest reliability shows further refinement of some items in the tool is necessary.

In the final study, the acceptability and feasibility of a four-week intervention integrating wellbeing and lifestyle behaviours in an innovative way is explored. Drawing together findings of the preceding studies, key components of the intervention include the BE Well tool, social support, non-prescriptive self-tailored challenges (one per week), and a penalty. Qualitative interviews ($N=25$) show strengths of the intervention include the BE Well audit tool and tailored challenges. Limitations include the penalty and limited interactive content. The social support component received polarising feedback. Of the 89 challenges, the majority (59%) focused on lifestyle behaviours including nutrition (22%), sleep (20%), and exercise (17%). Outcomes from the final series of studies indicate targeting lifestyle behaviours for positive health is a strategy that engages laypersons.

In this thesis, positive psychology and public health were integrated to assess the biological plausibility, epidemiological evidence, and translation of positive health. In doing so, this doctoral research makes a substantial contribution to refining a framework for positive health. The challenge now is to continue to reorient the deficit-based health system toward promoting positive health. For this to occur, further evidence and testing of positive health initiatives will be required to gain financial, public, and political support.

Chapter 1

Introduction

Background

Context

“Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (p. 1315).¹ This holistic and positive notion of health is represented in the New Zealand Health Strategy which states that a fundamental principle is for “good health and wellbeing for all New Zealanders throughout their lives” (p. 7).² Despite this, the translation of positive health into practice remains limited.

New Zealand’s health system, like most societies, is deficit-based. The emphasis of this system, both fiscally and through practice, is on health risk, sickness, and injury. In essence, the health system has become synonymous with disease absence. A deficit-based health system is designed to address problems; physical problems (e.g., smoking, chronic disease), mental problems (e.g., depression, anxiety), and social problems (e.g., family violence, gambling).³ Within New Zealand’s deficit-based health system, health targets are measured by reduced wait times for surgery, decreased smoking rates, and increased screening for chronic disease.⁴ Thus, knowledge and understanding of how to promote positive health is limited.

Critics might observe that the Health Promotion Agency has been established as the Crown entity to “promote health and wellbeing and encourage healthy lifestyles”.⁵ Yet of New Zealand’s annual NZ\$15.6 billion healthcare budget,⁶ the Health Promotion Agency receives only NZ\$25-\$33 million, of which the bulk spending is on harm reduction (e.g., reducing alcohol, gambling, and smoking).⁵ Where healthy lifestyle behaviours—such as nutrition and physical activity—are promoted, in reality the target is to decrease health risk. Whilst the same behaviours can both prevent disease and increase health, it is argued the distinction is in the focus.⁷

Meeting the costs of a system that prioritises the treatment and management of illness and injury is unsustainable. Healthcare expenditure in New Zealand has increased by NZ\$2,404 per

person over the past 50-years, in inflation-adjusted dollars.⁸ Of concern, however, is that this increase in spending has not been paralleled by improvements in health quality. Although New Zealanders are living longer, on average 20% of their lives are spent in poor health.^{9; 10} Similar to international trends,¹¹ research shows the prevalence of chronic disease and psychological illness in New Zealand are trending upwards.^{10; 12} In light of these limitations with the current health system, the Ministry of Health recently urged the incoming Health Minister, in a briefing document, to lead the shift toward a wellness model.⁸

Positive psychology and public health

Promoting health and wellbeing through a positive health framework provides an ideal alternative to current deficit-based health systems. Positive health centres on understanding conditions and behaviours that support physical, mental, and social wellbeing.^{3; 13; 14} In doing so, positive health complements disease treatment and prevention to provide a more complete and holistic representation of health.^{3; 13; 14}

Two disciplines that can contribute toward both understanding positive health and addressing the disconnect between policy and practice are positive psychology and public health.^{3; 13; 15} Situated within the field of psychology, positive psychology is a discipline that challenges deficit-based systems by explicitly focusing on wellbeing.^{16 17; 18; 19; 20} From positive psychology, robust articulations of flourishing—or optimal wellbeing as it will hereon be referred—have emerged, which extend beyond traditional measures of life satisfaction.^{17; 18; 19; 20} Optimal wellbeing is used to describe and understand high levels of feeling good (e.g., happiness, positive emotions, satisfaction with life) and functioning well (e.g., positive relationships, meaning and purpose).^{17;}

18; 19; 20

Whilst positive psychology has gone some way toward translating the promotion of wellbeing into practice,^{21; 22; 23; 24; 25} the discipline has been criticised for adopting a ‘neck up’ approach.²⁶ Consequently, positive psychology has neglected to consider the role lifestyle behaviours might play in maintaining or enhancing optimal wellbeing. Given lifestyle behaviours are central to day-to-day living and underpin optimal biological functioning,^{27; 28; 29; 30} understanding the relationship between lifestyle behaviours and optimal wellbeing is important within the context of positive health. Public health on the other hand, recognises the need to promote lifestyle

behaviours at the population level, but in reality, the focus has been on disease prevention. To move the deficit-based health system toward a framework for positive health, a better integration of positive psychology and public health is needed.

Thesis rationale

Statement of the problem

It is evident that in New Zealand, there is a disconnect between positive health policy and deficit-based practice. This reality has led to significant gaps in understanding and application of positive health. In light of the unsustainable costs of a deficit-based system and lack of evidence to indicate health quality is improving, exploring approaches for promoting health beyond the absence of disease should be considered. Investigating how positive psychology and public health can be integrated to reorient toward a framework for positive health warrants further investigation.

As a first step, a more comprehensive understanding of the link between lifestyle behaviours and positive psychology's multi-dimensional notion of optimal wellbeing is required. There is evidence to show lifestyle behaviours can be used to improve health,^{27; 28; 29; 30} but whether they can also improve optimal wellbeing is currently unclear. Investigating whether the link between lifestyle behaviours and optimal wellbeing is biologically plausible provides a starting point. In addition, exploring the relationship between lifestyle behaviours and optimal wellbeing in a large population sample is important for establishing behaviours to target in a positive health intervention.

In response to evidence that shows health risk behaviours cluster,^{54; 55; 56; 57} some public health researchers argue that the limited practice of promoting multiple lifestyle behaviours, concurrently, should be increased.^{31; 32; 33} Subsequently, it would be an advantage to investigate whether isolated or multiple lifestyle behaviours should be promoted in a framework for positive health. Extending the health risk research,^{54; 55; 56; 57} to explore associations between multiple healthy lifestyle behaviours and optimal wellbeing, and the clustering of lifestyle behaviours for positive health is warranted.

Increasing understanding of the relationship between lifestyle behaviours and optimal wellbeing will act as an important platform for reorienting toward a framework for positive health. However, to implement this knowledge and address the gap between positive health policy and deficit-based practice, the translation of positive health is required. Such research is necessary for developing insights into how to communicate behaviours for positive health effectively and for understanding how to implement positive health in the real-world setting.

To address current gaps in knowledge and discern how to communicate messages within a framework for positive health, formative research should be considered. Formative research enables the tailoring of messages to a target audience preference and can improve the feasibility, effectiveness, and likelihood of developing sustainable messages.^{34; 35} One strategy for developing insights into laypersons' preferences for communicating lifestyle behaviours is to explore perceptions of lifestyle behaviour guidelines and corresponding messages. Such research is currently limited in New Zealand. A second approach that might be appropriate for developing insights into the communication of positive health messages is to explore messages in popular media. As success in both public health and popular media is reliant on appealing to the public, exploring popular lifestyle books and podcasts might provide novel insights into behaviour change strategies that appeal to the public.

There are limited initiatives integrating wellbeing and lifestyle behaviours in practice. Consequently, research exploring how to implement positive health in a real-world setting is important. To meet the needs of individuals and population groups, the ability to prioritise the most appropriate wellbeing or lifestyle behaviours in an intervention or clinical setting would be beneficial. However, no instrument to assess satisfaction across multiple wellbeing and lifestyle behaviours, concurrently, is available. Prior to implementing large-scale trials of positive health interventions, it is also important to determine whether positive health initiatives are feasible and acceptable in a real-world setting.

Statement of purpose

This thesis integrates positive psychology and public health approaches. The overarching aim of this doctoral research is to explore an approach for reorienting toward a framework for positive health.

Specific objectives of the research are:

1. To explore the biological plausibility of the relationship between lifestyle behaviours and wellbeing using a hormetic model. (Chapter 2)
2. To use an epidemiological approach to determine whether:
 - a. Lifestyle behaviours are associated with a multi-dimensional measure of optimal wellbeing. (Chapter 3)
 - b. Those engaging in multiple healthy lifestyle behaviours are more likely to reach the criteria for optimal wellbeing. (Chapter 4)
 - c. Lifestyle behaviours cluster or occur independently in a large and diverse sample of New Zealand adults. (Chapter 4)
3. To explore the translation of positive health into practice. (Chapters 5-8)
 - a. To use formative work to identify how lifestyle behaviours can be promoted within a positive health framework in a way that is acceptable and resonates with the public by exploring:
 - i. What laypersons like and understand from nutrition, physical activity, and sleep guidelines. (Chapter 5)
 - ii. Popular lifestyle behaviour messages in lifestyle books and podcasts. (Chapter 6)
 - b. To implement positive health into practice by:

- i. Developing a brief tool that can be used to identify quickly the positive health behaviours individuals are least and most satisfied with. (Chapter 7)
- ii. Developing and evaluating the acceptability and feasibility of a positive health intervention. (Chapter 8)

Significance of the research

The New Zealand Ministry of Health is urging for the health system to shift toward a wellness focus.⁸ Nevertheless, reorienting from deficit-based practice to positive health is unlikely to occur without robust evidence. Whilst exploratory in nature, this doctoral research provides an initial and timely focus on positive health. The studies comprising the thesis not only make novel contributions to research, but also have wider implications.

This thesis makes a significant contribution to wellbeing epidemiology both in New Zealand, and internationally. The first epidemiological assessment of the relationship between lifestyle behaviours and a multi-dimensional measure of optimal wellbeing is provided. In addition, the research builds on previous work to investigate for the first time the clustering of sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake in a large and diverse sample. Finally, the association between engaging in multiple healthy lifestyle behaviours and optimal wellbeing is explored for the first time.

Laypersons' perceptions are valuable for guiding the research direction of this thesis. To the best of knowledge, the work in this thesis provides the first qualitative evaluation of laypersons' perceptions of nutrition, physical activity, and sleep guidelines in New Zealand. In addition, a novel evaluation of books and podcasts shows for the first time that lifestyle behaviours are promoted concurrently in popular media. Together the formative evaluations provide novel insights into how laypersons prefer lifestyle behaviours to be promoted.

There is a paucity of translational research integrating positive psychology and public health initiatives. Thus, a novel contribution of this thesis is integrating the promotion of multiple wellbeing and lifestyle behaviours to address the disconnect between positive health policy and deficit-based practice. To guide the development of positive health initiatives, an original tool to assess individuals' satisfaction across multiple wellbeing and lifestyle behaviours is developed.

It is anticipated the tool will have relevance in both clinical and population-level settings. In addition, an intervention comprising innovative components including non-prescriptive tailored challenges is implemented. The outcomes of this thesis make a significant contribution to the body of knowledge through the translation of positive health into practice

The exploratory work comprising the thesis provides a starting point for guiding research and practice using a positive health framework. It is anticipated that disseminating pertinent findings from the thesis will act as a platform for initiating timely discussion about positive health.

Study delimitations

Parameters specific to this body of work are:

1. Optimal wellbeing was defined according to Huppert and So¹⁸ and consequently provides an overall estimation wellbeing across these parameters.
2. In Chapters 3 and 4, lifestyle behaviours were measured using self-report, rather than objective measures such as accelerometers.
3. Data collected were cross-sectional, thus causality cannot be inferred.
4. Data for Chapter 5 were collected between November 2014 and January 2015, prior to the release of the Eating and Activity Guidelines in October 2015. Consequently, the 2003 Food and Nutrition Guidelines for Healthy Adults and 2001 Physical Activity Guidelines for Adults are explored in Chapter 5.
5. The sample sizes in Chapters 5, 8, and 9 are appropriate for formative and feasibility work, but the results may not be generalizable to wider populations.
6. Within the resource constraints (time and financial) of the doctoral research, a sample size with enough power to detect the smallest worthwhile effects was unable to be recruited for the feasibility study (Chapter 8). In light of these constraints and the exploratory nature of the feasibility study, no self-report or objective measures of health or wellbeing were collected in this study.

Thesis overview

Thesis organisation

The thesis comprises a series of nine research chapters designed to address the overall thesis aim and objectives (Figure 1).

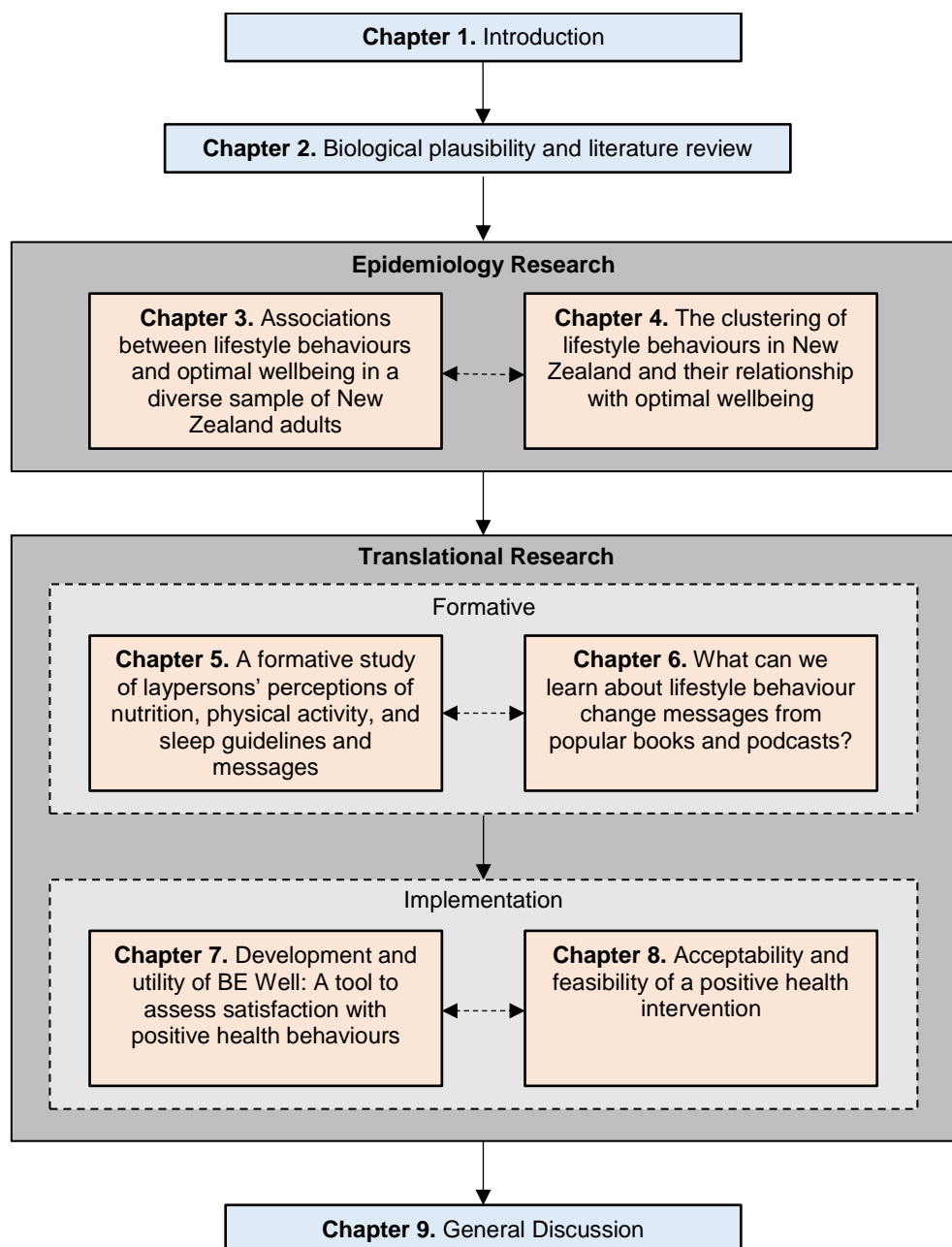


Figure 1. Overview of thesis structure

Chapters 3 to 8 are published, or are in preparation for submission, in peer-reviewed journals. Consequently, these chapters have been prepared to stand-alone and repetition of some

information occurs, particularly through the introduction and methods sections. Each chapter begins with a preface, which serves to demonstrate the sequential progression and brings together the thesis as a cohesive whole.

Chapter 1 provides the background context and thesis aims. Chapter 2 explores the biological plausibility of the relationship between lifestyle behaviours and optimal wellbeing using a hormetic model. In addition, the strengths and limitations of positive psychology and public health within a framework for positive health are reviewed.

Chapters 3 and 4 comprise a series of epidemiological research. Specifically, Chapter 3 focuses on associations between lifestyle behaviours and a multi-dimensional measure of optimal wellbeing. While Chapter 4, explores the association between multiple lifestyle behaviours and optimal wellbeing, and the clustering of lifestyle behaviours.

Findings from the epidemiological chapters provide the rationale for including multiple lifestyle behaviours within a positive health framework. Chapters 5-8 focus on the translation of positive health into practice through formative research (Chapters 5-6) and through implementation (Chapters 7-8). The formative research explores how lifestyle behaviours can be promoted in a way that appeals, engages, and resonates with the public. In Chapter 5, laypersons' perceptions of nutrition, physical activity, and sleep guidelines are explored. Chapter 6 utilises an innovative approach to identify popular behaviour change messages. Specifically, messages in popular lifestyle books and podcasts are reviewed.

Based on the convergence of findings, Chapters 7-8 focus on integrating multiple lifestyle behaviours and wellbeing to implement a positive health intervention. In Chapter 7, a tool (BE Well) comprising multiple positive health behaviours is developed to identify which behaviours individuals prioritise for change. In addition, the utility of the tool is tested in an intervention setting. In Chapter 8, the acceptability and feasibility of a positive health intervention are explored.

Finally, the thesis concludes with a general discussion integrating findings from the preceding chapters (Chapter 9). Contributions to the literature, wider implications, study limitations, and directions for further work are discussed.

Candidate contributions

Data analysed in Chapters 3 and 4 is drawn from the Sovereign Wellbeing Index (Round 1), a research project currently being undertaken by a research team at the Human Potential Centre. Since the inception of the project in 2011, I have made significant and ongoing contributions.

My specific contributions to the wider Sovereign Wellbeing Index project include:

- Preparing the ethics application for the research and successfully obtaining ethical approval
- Survey development (including item selection and testing)
- Data cleaning
- Data analysis
- Report writing

Work for Chapters 3 and 4, including statistical analysis and drafting of the manuscript, was undertaken by myself, independently of the wider research team. Data for the remaining chapters (Chapters 5-8) were collected for the sole purposes of the thesis.

Research chapter contributions

Chapters 3–8 of the thesis comprise scientific papers that are published (or in preparation for submission) in international peer-reviewed journals. The academic contributions for these chapters are as follows:

Chapter 3: *Associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults.*

Kate Prendergast (80%: Lead author, 100% data analysis), Grant Schofield (10%),
Lisa Mackay (10%).

Chapter 4: *The clustering of lifestyle behaviours in New Zealand and their relationship with optimal wellbeing.*

Kate Prendergast (80%: Lead author, 100% data analysis), Lisa Mackay (10%),
Grant Schofield (10%).

Chapter 5: *A formative study of laypersons perceptions of nutrition, physical activity, and sleep guidelines and messages.*

Kate Prendergast (80%: Lead author, 100% transcribing, 100% data analysis), Lisa Mackay (15%), Grant Schofield (5%).

Chapter 6: *What can we learn about lifestyle behaviour change messages from popular books and podcasts?*

Kate Prendergast (80%: Lead author, 100% data analysis), Grant Schofield (15%), Lisa Mackay (5%).

Chapter 7: *Development and utility of BE Well: A tool to assess satisfaction with positive health behaviours.*

Kate Prendergast (80%: Lead author, 100% data analysis), Lisa Mackay (10%), Grant Schofield (10%).

Chapter 8: *Acceptability and feasibility of a positive health intervention.*

Kate Prendergast (80%: Lead author, 100% transcribing, 100% data analysis), Lisa Mackay (10%), Grant Schofield (10%).

Co-author agreement



Professor Grant Schofield



Dr Lisa Mackay

Chapter 2

Literature Review

Preface

A positive health framework is ideal for promoting health at a “state of complete physical, mental, and social wellbeing beyond the absence of disease” (p. 1315).¹ However, to promote this positive notion of health an inter-disciplinary approach is required. The disciplines of positive psychology and public health each offer unique contributions toward a positive health framework. In positive psychology, for example, rather than focusing on the treatment of ill-being, explicit attempts are made to promote wellbeing. However, positive psychology initiatives have neglected to consider the fundamental role lifestyle behaviours play in maintaining wellbeing. Public health on the other hand, promotes lifestyle behaviours, but does so primarily to prevent disease. Examples of initiatives promoting lifestyle behaviours for optimal wellbeing are limited.

In Chapter 2, a hormetic model is used to investigate the biological plausibility of the relationship between lifestyle behaviours and optimal wellbeing. Literature from positive psychology and public health is reviewed to identify the unique contributions each discipline can make toward a positive health framework. In addition, the limitations of positive psychology and public health are critiqued through a positive health lens.

Context

“Health is a state of complete physical, mental and social well-being and not merely the absence of disease” (p. 1315).¹ In defining health as both holistic and positive, the World Health Organization provides a broad agenda for positive health.^{1; 36; 37} Nevertheless, the prevailing and funded health systems in most societies are deficit based,³⁸ and New Zealand’s health system is no exception. Research and practice centre on understanding, mitigating, preventing, and treating disease.³⁸ The assumption of deficit systems is that health and wellbeing prevail in the absence of disease.³ Returning individuals from states of negative health, back to neutral is the reality of these systems (Figure 2).^{3; 38} Accordingly, insufficient consideration has been given to understanding and promoting positive health.

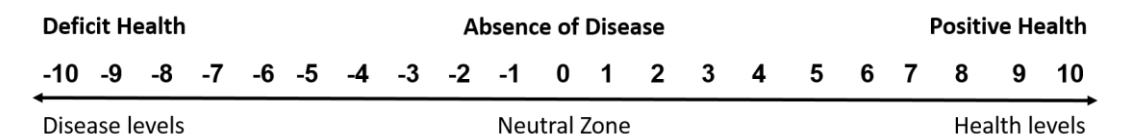


Figure 2. Disease-health continuum

Current health systems operate within the negative half of the continuum. Restoring individuals to the “neutral zone” is the reality of current health systems. Adapted from Brussow³⁸

Critics may argue that a fundamental principle of the New Zealand Health Strategy is to promote “good health and wellbeing for all New Zealanders throughout their lives” (p. vii).² In spite of this, current health targets in New Zealand remain pathology focused: shorter stays in emergency departments; improved access to elective surgery; shorter waits for cancer treatment; increased immunisation; better help for smokers to quit; and more heart and diabetes checks.⁴ These six health targets focus on the treatment and prevention of disease, rather than the promotion of health.³⁹

Arguably, a deficit system also governs health promotion. In New Zealand, the Health Promotion Agency is the Crown entity tasked with promoting population “health, wellbeing, and healthy lifestyles”.⁵ However, the majority of the agency’s budget is directed toward reducing gambling, smoking, and alcohol consumption.⁵ Similarly, the Health Promotion Agency’s mental health programmes focus on depression, reducing stigma, and discrimination.⁵ This is in spite of the agency’s aim “for New Zealanders to experience positive mental health and wellbeing”.⁵

Where positive lifestyle behaviours, such as nutrition and physical activity, are promoted the emphasis is on reducing obesity, diabetes, and cardiovascular disease.⁵ Guomundsdottir⁷ argues that even though the same behaviours can both prevent disease and optimise health and wellbeing; the distinction is in the focus.

There is no doubting that treating disease and reducing harm is both important and necessary. However, meeting the costs of a health system that prioritises the treatment and management of episodes of illness is becoming increasingly unsustainable.⁸ Findings from a recent New Zealand Treasury report show over the past 50-years, health spending has been increasing at a faster rate than gross domestic product.⁴⁰ New Zealand's NZ\$15.6 billion health budget now comprises 21% of government expenditure and 6% of gross domestic product.^{6; 41} In a recent report it was observed that health spending per person increased five-fold between 1950 and 2011, in inflation adjusted dollars.⁸

Despite increases in healthcare expenditure, there is limited evidence of corresponding improvements in health quality. Although life expectancy has improved, rates of chronic disease continue to rise.^{10; 12} On average, New Zealanders now spend one fifth of their lives in poor health.¹⁰ In an attempt to address these issues, funding has been directed toward diabetes and cardiovascular disease checks.⁴² Consequently, moderate and higher risk individuals are provided with lifestyle advice and treatment to "substantially prevent the occurrence of heart attacks and strokes" (p. 18).⁶ However, to promote health beyond the absence of disease, health promotion needs to move beyond prevention. Concerted efforts to encourage individuals not at 'health risk', or sick, or injured to maintain or improve their health and wellbeing is likely to have widespread individual, social, and economic benefits.

The benefits of high levels of physical, mental, and social wellbeing provide a compelling case for reorienting the health system toward positive health. Outcomes associated with high levels of mental and social wellbeing include enhanced social relationships,⁴³ increased community participation,⁴³ higher social capital,⁴⁴ increased productivity,^{19; 45} higher levels of job satisfaction,^{45; 46} and increased health and longevity.^{19; 47; 48} In addition, research shows improved health is associated with increased productivity⁴⁹ and satisfaction with life.^{10; 50; 51; 52}

Whilst poor health is associated with morbidity and mortality,⁵³ and increased healthcare expenditure.^{54; 55}

Fundamental shortcomings of deficit health systems, including negligible attempts to implement wellbeing policy, exponential increases in healthcare expenditure, and the failure to stem the steady rise in chronic disease, warrants investigating approaches for the application and promotion of positive health.

Positive health

*“The role of the health sector must move increasingly in a health promotion direction, beyond its responsibility for providing clinical and curative services”, Ottawa Charter for Health Promotion, 1987.*⁵⁶

A positive health framework provides an ideal alternative to current deficit health systems. Positive health centres on understanding conditions and behaviours that support physical, mental, and social wellbeing.¹³ In doing so, positive health complements disease treatment and prevention to provide a more complete and holistic representation of health.¹³ Whereas deficit health systems default toward targeting individuals or groups at ‘health risk’, a positive health framework adopts a whole-of-population focus. In keeping with the World Health Organization’s principle that “the highest attainable standard of health is a fundamental right of every human” (p. 1315)¹, the objective of promoting positive health is to shift the entire population toward physical, mental, and social wellbeing (Figure 3).

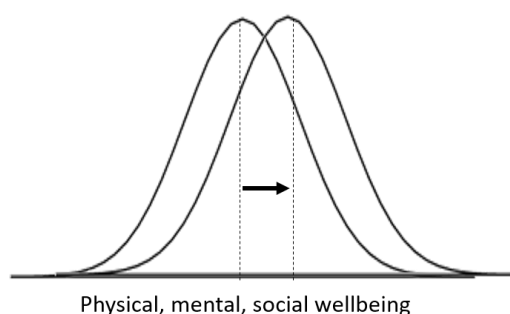


Figure 3. A whole-of-population approach to positive health

The aim of promoting positive health is to shift the whole population toward physical, mental, and social wellbeing

In considering physical, mental, and social wellbeing, positive health focuses on the interconnections between the body and mind.^{3; 14; 37; 57; 58} In their 1998 seminal article, Ryff and Singer³ suggest that a comprehensive understanding of positive health requires assessing “both physical and mental wellbeing, and the ways in which they influence each other” (p. 2). Ryff and Singer,³ acknowledge exploring the relationship between physical and mental wellbeing is not new, however, they argue that previous research mostly seeks to understand how poor physical wellbeing influences poor mental wellbeing, and vice versa.³

A decade later, Seligman,¹⁴ a prominent positive psychologist, proposed a new discipline entitled ‘positive health’. Similar to Ryff and Singer, he recommended that the discipline of positive health centre on the subjective, functional, and biological correlates of optimal health and wellbeing.¹⁴ Over the last decade, the notion of positive health has gained traction with multiple commentaries and reviews emerging.^{13; 14; 15; 39; 57; 59; 60; 61} In spite of this increasing interest, efforts to translate and promote the holistic concept of positive health into real-world settings are limited.

Positive psychology and public health

Two disciplines that can assist in translating the concept of positive health into practice are positive psychology and public health. Positive psychology challenges the assumptions of deficit health through its explicit focus on wellbeing.¹³ Positive psychology not only provides robust articulations of mental wellbeing and social wellbeing through the emerging concept of flourishing—or optimal wellbeing,^{17; 18; 19; 62} but has also begun to translate wellbeing into practice.^{21; 22; 23; 24; 25} We argue, however, that in translating wellbeing into practice, positive psychology has neglected to consider the role lifestyle behaviours might play in maintaining or optimising wellbeing. Positive psychology has been criticised for remaining a ‘neck up’ discipline.²⁶

Lifestyle behaviours—such as healthy eating, regular physical activity, and sufficient sleep—are likely to be essential for positive health. These lifestyle behaviours are not only central for day-to-day living, but they also underpin optimal health.^{27; 28; 29; 30} In public health, initiatives and programmes targeting lifestyle behaviours explicitly to improve optimal wellbeing are limited. Nevertheless, evidence is emerging to suggest several biological pathways may causally link

lifestyle behaviours to optimal wellbeing.⁶³ Investigating the biological plausibility of this relationship provides a starting point for determining whether lifestyle behaviours might be useful for promoting positive health.

Part One: Exploring a biological link between lifestyle behaviours and optimal wellbeing

There is a large body of epidemiological and biological evidence to show lifestyle behaviours are important for optimal health.^{27; 28; 29; 30} However, the epidemiological and biological relationships between lifestyle behaviours and optimal wellbeing are less well understood. Emerging evidence indicates there are biologically plausible links between lifestyle behaviours and optimal wellbeing, which potentially explain a causal relationship. Nevertheless, this research is haphazard and mainly focuses on nutrition and exercise (e.g., see Gomez-Pinella⁶³). The purpose of this section is to use a hormetic model to investigate the biological plausibility of the relationship between lifestyle behaviours and optimal wellbeing.

Hormetic model of wellbeing

Dimensions important for optimal wellbeing include high levels of positive emotion, resiliency, creativity, learning, and problem solving.^{17; 18; 20; 64; 65} There is accumulating evidence to show these important dimensions are underpinned by 'neuroplasticity'.^{66; 67; 68} Consequently, neuroplasticity is increasingly being recognised as the biological representation of mental health.^{63; 66; 69; 70; 71} Thus, enhancing neuroplasticity is likely to be both necessary and important for optimising wellbeing.

Neuroplasticity represents a dynamic and flexible nervous system that is constantly reorganising its structure, function, and connections in response to stressors.^{66; 68; 71; 72; 73} This ability to constantly reorganise and create connections is what underpins the important components of optimal wellbeing; positive emotion, resiliency, creativity, learning, the creation of memories, and problem solving.^{66; 67; 68} Adaptive neuroplasticity is associated with gains in function.⁶⁸ In contrast, maladaptive neuroplasticity, compromises the nervous system.⁶⁸ Research shows consequences of maladaptive neuroplasticity include depression, anxiety, and impaired cognitive functioning.^{68; 73; 74; 75}

Biological conditions supporting neuroplasticity

Over the last two decades, evidence to show that adults' neuroplasticity can be enhanced by a range of factors—including via adaptive stress responses—has been accumulating.⁶⁶ Adaptive stress responses drive certain biological conditions important for neuroplasticity including: brain derived neurotrophic factor (BDNF),^{76; 77; 78; 79; 80} insulin and insulin like-growth factor-1 (IGF-1),^{81; 82; 83; 84; 85} and reactive oxygen species (ROS)^{86; 87; 88} (Table 1).

Table 1. Biological correlates of optimal wellbeing

	Effects on neuroplasticity	Mechanisms/Pathways	Too little	Too much
BDNF	Direct: Survival and differentiation of neurons, neurogenesis, synaptic plasticity. ^{76; 77; 78; 79; 80}	CREB, MAPK and NF-kB pathways ^{21; 39}	Decreased neuroplasticity	--
Insulin/IGF-1	Direct: Nerve growth and differentiation, neurotransmitter synthesis and release, glucose metabolism. ^{81; 82; 83; 84} Indirect: Stimulates BDNF ^{89; 90; 91}	IGF-1 and BDNF act synergistically to suppress glutamate increased CA ²⁺ ⁹⁰	Deficient states, low serum insulin and/or IGF-1 levels. ^{85; 85}	Resistant states, high serum insulin and/or IGF-1 levels. ⁸⁵
ROS	Direct: Neurogenesis, mitochondrial metabolism, and neutrophil activation ^{18; 27} Indirect: Stimulates BDNF ^{92; 93}	Activation of CREB, Nf-kB, Nrf2-ARE ⁹⁴	Insufficient stress, cells unable to adapt ^{86; 95; 96}	Excessive accumulation of ROS, oxidative damage occurs ^{86; 87; 88; 95}

BDNF is increasingly considered to be an index of neuroplasticity.⁷⁴ BDNF is a growth factor and mediates neuroplasticity directly through the survival and differentiation of neurons, neurogenesis, and synaptic plasticity.^{76; 77; 78; 79; 80} For optimal wellbeing, increased expression of BDNF is desirable.

Low levels of insulin and moderate levels of IGF-1 are conditions that support neuroplasticity.⁸⁵ Like BDNF, IGF-1 is also a growth factor and enhances neuroplasticity through nerve growth and differentiation, neurotransmitter synthesis and release, and glucose metabolism.^{81; 82; 83; 84} Maladaptation occurs as a result of both low serum insulin and/or IGF-1 levels⁸⁵ and high serum insulin and/or IGF-1 levels.⁸⁵

ROS occur as part of normal cellular function in response to a variety of stressors, including environmental factors and lifestyle behaviours.^{86; 87; 88} At optimal levels ROS play a central role in mediating neuroplasticity; both directly and indirectly through its effects on BDNF.^{86; 87; 88} Research shows that low-to-moderate levels of ROS lead to adaptive neuroplasticity.⁷⁷ In contrast, maladaptive neuroplasticity occurs as a result of both excessive accumulation^{86; 87; 88; 95} and very low levels of ROS.^{95; 96}

Favourable changes to the biology underpinning neuroplasticity include increased BDNF, low insulin and increased IGF-1, and low levels of ROS. Supporting these biological conditions is therefore central to neuroplasticity and optimal wellbeing.

Hormesis

Although the mechanisms sometimes vary, there is accumulating evidence to show lifestyle behaviours mediate BDNF, insulin and IGF-1, and ROS by acting as hormetic stressors (Figure 4).^{63; 93; 97} Hormesis is a term from toxicology that is used to describe an inverted U-shaped dose-response to a stressor.⁹⁷ The essence of hormesis is that some stress is essential for beneficial adaptation to occur, but too much or too little stress leads to maladaptive responses (Table 2).^{97; 98; 99; 100; 101; 102} What this means for optimal wellbeing, is that exposure to appropriate levels of stress is necessary.⁶³ However, too little or too much stress results in decreased neuroplasticity and consequently, decreased wellbeing.⁶³

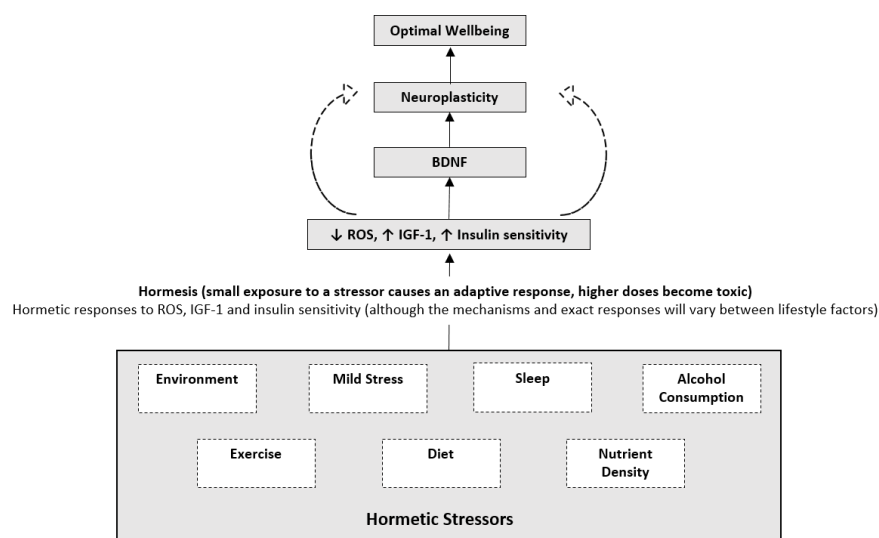


Figure 4. Hormetic model of wellbeing

Multiple hormetic stressors concurrently affect brain-derived neurotrophic factor (BDNF), reactive oxygen species (ROS), insulin and insulin like growth factor-1 (IGF-1).

Adaptive doses of the concurrent hormetic stimuli lead to increased neuroplasticity resulting in increased optimal wellbeing.

Pertinent to consider when promoting lifestyle behaviours for neuroplasticity and optimal wellbeing is that responses to hormetic stressors are highly individualised.⁹⁸ At any point in time, an individual is exposed to concurrent hormetic stressors, for example, exercise, diet, stress, sunlight, and pollution.⁹⁸ Consequently, the magnitude of an individual's response to an isolated stressor is dependent on the integrated response of multiple stressors.⁹⁸ An amalgamation of factors will influence an individual's response to a stressor including:

- Genes, age, gender, and ethnicity;
- Past and current exposure to the hormetic stressor;⁹⁸ and
- Past and current exposure to other hormetic stressors.⁹⁸

These factors suggest the 'dose' of stress required to induce an adaptive hormetic response will differ both between and within individuals.^{98; 102} Exploring alternatives to generic one-size-fits public health initiatives is, therefore, likely to be important for promoting optimal wellbeing and positive health.

Table 2. Summary of hormetic responses

Hormetic response	Example
Stress is necessary for beneficial adaptation.	<i>Exercise with enough time to rest and recover results in adaptation.</i>
Too much stress leads to maladaptive responses.	<i>Overtraining results in maladaptation.</i>
Too little stress leads to maladaptive responses.	<i>Inactivity results in maladaptation.</i>
Individuals are exposed concurrent hormetic stressors. The integrated response of these stressors needs to be considered.	<i>High volume exercise on top of insufficient sleep, chronic stress, and an unhealthy diet may be maladaptive.</i> <i>The same exercise on top of sufficient sleep, healthy eating, and cognitive challenge (but not stressed), is likely to elicit beneficial adaptation.</i>
The 'dose' of stress required for adaptation will differ based on genetic and demographic profiles, absence, presence, and history of exposure to hormetic stressors.	<i>An individual that is regularly active will have a different response to exercise, compared with a sedentary individual.</i>

Lifestyle behaviours mediate neuroplasticity

Beneficial changes to neuroplasticity occur when lifestyle behaviours activate adaptive stress responses in cells (Table 3).^{82; 99} Nevertheless, research suggests that chronic under- or over-exposure to hormetic stressors can result in maladaptive changes including decreased BDNF, insulin resistance, adverse levels of IGF-1, and ROS induced inflammation (Table 1).

Exercise for optimal wellbeing

There is consistent evidence in the literature to show exercise induces hormetic responses to enhance the biological correlates of neuroplasticity and optimal wellbeing.^{81; 91; 103; 104; 105; 106; 107; 108; 109} Under the right conditions, including sufficient rest and recovery, regular exercise acts as a stressor to induce adaptation.¹¹⁰ For adaptation to occur, sufficient levels of exercise-induced stress are required.¹¹⁰ Whilst inactive individuals are likely to adapt to lower levels of exercise-induced stress, active individuals will require additional stress for the same adaptive benefits to occur.¹¹⁰ However, research shows excessive exercise attenuates the ability of cells to adapt and can result in decreased neuroplasticity.¹⁰⁴ Together, this research highlights the importance of considering individuals' needs and current exposure to exercise and other hormetic stressors.

There is evidence to show low intensity, aerobic exercise enhances the biological correlates of neuroplasticity. However, emerging evidence suggests the magnitude of change in BDNF, insulin and IGF-1, and oxidative capacity is greater for short duration, high intensity exercise.^{106;}

111; 112; 113; 114 High intensity exercise protocols activate oxidative stress responses and enhance anti-oxidant uptake.¹⁰⁸ Likewise, high intensity exercise increases insulin sensitivity.^{106; 111} These findings suggest that high intensity exercise may confer extra benefits for neuroplasticity and optimal wellbeing.

Table 3. Lifestyle behaviours and associations with BDNF, insulin, IGF-1, and ROS

	BDNF	Insulin sensitivity	IGF-1	ROS
Exercise				
Regular exercise	Increase 103; 104; 105	Increase 106	Increase 104; 107	Decrease 108
Physical inactivity	Decrease 115*	Decrease 116	Decrease 83*	Increase 117*
Nutrition				
Intermittent fasting	Increase 118*	Increase 119; 120	Increase 120	Decrease 120
Nutrient dense diet	Increase 97**	Increase 121	Increase 122	Decrease 97**
High sugar diet	Decrease 123*;124*	Decrease 124*	Decrease 125*	Increase 126
Other lifestyle behaviours				
Insufficient sleep	Decrease 127	Decrease 128*	Decrease 128*	Increase 96*
Too much alcohol	Decrease 129	Decrease 130*	Decrease 131*	Increase 132*

*indicates animal study; ** review

Nutrition for optimal wellbeing

Over the last decade, there has been increasing interest in the hormetic interplay between nutrition and neuroplasticity. From animal studies, there is accumulating evidence to show unhealthy diets, comprising both high fat and high sugar, attenuate neuroplasticity.^{123; 124; 126; 133} Experimental evidence from animal studies shows high fat and high sugar diets increase ROS production,¹²⁶ decrease BDNF levels,^{123; 124} and lead to IGF-1 and insulin resistance.¹²⁴ On the other hand, whole and unprocessed foods contain phytochemicals which, in low amounts activate adaptive stress response pathways.⁹⁷

There is also increasing evidence to suggest that neuroplasticity, and therefore optimal wellbeing, is inextricably linked with glucose metabolism. In a cross-sectional study of 233

humans, BDNF levels were significantly lower among type 2 diabetics in comparison to non-diabetics, after controlling for obesity.¹³³ Additional findings from the study show that during a hyperglycaemic clamp test, BDNF from the brain was inhibited when blood glucose levels were elevated in a sample of healthy subjects ($n=7$).¹³³ Although these findings were cross-sectional and from a small sample, respectively, they warrant further investigating the implications of sugar consumption and processed foods on optimal wellbeing.

Sleep for optimal wellbeing

There is consensus that sleep supports neuroplasticity.¹³⁴ In contrast, sleep deprivation has been shown to cause a reduction in neurogenesis.^{134; 135} Sleep plays a role in the regulation of insulin,^{128; 136; 137} IGF-1,¹²⁸ and BDNF secretion.^{127; 138; 139} For optimal wellbeing, it is likely to be important to not only emphasise sleep duration, but also sleep quality. Sleep is divided into two states, rapid eye movement sleep and non-rapid eye movement sleep.¹⁴⁰ Greater improvements in neuroplasticity are likely to occur if an individual goes through the complete sleep cycle.¹³⁴

Concurrent lifestyle behaviours and neuroplasticity

The hormetic effects of individual lifestyle behaviours are clear. However, there has been little consideration of the concurrent effects of multiple lifestyle behaviours on BDNF, insulin and IGF-1, and ROS. The results of a recent animal study show that the combined effects of a high fat, high sugar diet and insufficient sleep decreased BDNF and BDNF mediated neuroplasticity more than diet or sleep alone.⁹⁶ In addition, findings from a recent observational study of post-menopausal women show chronic stress and high sugar, high fat food had synergistic adverse effects on oxidative stress and insulin sensitivity.¹⁴¹ Together these findings suggest that engaging in multiple healthy lifestyle behaviours may synergistically improve optimal wellbeing. Further research exploring associations between multiple lifestyle behaviours and optimal wellbeing should be considered.

Summary

The hormetic model of wellbeing introduced in this section indicates that promoting lifestyle behaviours to enhance optimal wellbeing is biologically plausible. In addition, the concept of hormesis highlights important factors to consider in a positive health framework. Specifically, the

model shows individuals are exposed to multiple stimuli that concurrently influence the biology underpinning wellbeing. Promoting multiple healthy lifestyle behaviours concurrently may therefore have synergistic effects on optimal wellbeing. In addition, given the hormetic stressors that individuals are exposed to will vary; it might be pertinent to consider how promoting lifestyle behaviours for positive health can be tailored to meet the needs of individuals. Further epidemiological and experimental evidence exploring the relationship between lifestyle behaviours and optimal wellbeing is needed.

Part Two: Positive psychology and public health

The following section comprises a review of the literature from positive psychology and public health. Unique contributions each discipline can make toward a positive health framework are considered. In addition, the limitations of positive psychology and public health are critiqued through a positive health lens.

Positive psychology

Like the health system, traditional psychology operated within a deficit model where it was assumed wellbeing would prevail in the absence of pathology.^{16; 18} Within this traditional field there are valid and reliable conceptualisations and measurements of mental illnesses, such as depression and anxiety.^{142; 143} At the population level, epidemiology research has enabled the determinants and behaviours associated with mental illness to be identified. Similarly, there are examples of campaigns to raise awareness of depression, stigma, and discrimination.⁵ Until recently, psychologists paid little attention to understanding what it means to be well and flourishing. However, over the last decade this has begun to change.

Recognising little was known about the behaviours and conditions that support wellbeing, Seligman and Csikszentmihalyi¹⁶ outlined a framework for the science of positive psychology. Since Seligman and Csikszentmihalyi's seminal article 15-years ago, there has been a prolific increase in publications focusing on wellbeing science. This emerging research within positive psychology focuses on understanding assets, attributes, and qualities that enhance wellbeing to enable individuals, communities, and society to flourish and thrive.^{13; 16; 144; 145; 146} Instead of focusing on individuals who are ill, positive psychology has relevance to most people, most of the time.¹⁵

Defining and measuring optimal wellbeing

Defining optimal wellbeing

In public health, wellbeing has typically been defined and measured using measures of life satisfaction and happiness (e.g., Piqueras et al.⁵¹ and Grant et al.⁵⁰).¹⁴⁷ However, from positive psychology more complex conceptualisations and assessments of wellbeing have emerged. These emerging conceptualisations of optimal wellbeing date back to the ancient Greek philosophies of hedonism and eudaimonia.

The philosophy of hedonic wellbeing is characterised by a utilitarian approach and is primarily concerned with maximising positive emotions and avoiding negative emotions.^{148; 149} Hedonic wellbeing comprises subjective components including happiness, satisfaction with life, and the balance between positive and negative emotions.¹⁴⁸ Nevertheless, critics argue subjective wellbeing measures are weakly articulated, inadequately describe the “good life”, and fail to consider the sources of happiness.^{3; 18; 148; 150; 151; 152} For example, Delle Fave and Bassi.¹⁵² argue that anti-social behaviours, such as drug taking or stealing, may be pleasurable in the short term. However, such behaviours are likely to have detrimental long-term consequences.

On the other hand, eudaimonic theorists’ focus on positive functioning arguing there is more to life than maximising happiness.^{150; 151} Eudaimonic wellbeing comprises dimensions such as personal growth, meaning and purpose in life, social connections, engagement, mindfulness, autonomy, competence, and self-realization.^{148; 150; 153} Whereas hedonic wellbeing assesses positive feelings, eudaimonic wellbeing assesses positive functioning.^{18; 19; 153}

Until recently, wellbeing measures focused either on hedonic or eudaimonic wellbeing.^{18; 153; 154} Eminent positive psychologists now agree, however, that optimal wellbeing is a multi-dimensional construct comprising both hedonic and eudaimonic dimensions.^{17; 18; 19; 20} This broader and more complex notion of optimal wellbeing has emerged to describe those with the highest levels of wellbeing. Optimal wellbeing has relevance within a positive health framework as it extends beyond traditional measures, taking into consideration components of both positive feelings and positive functioning.

Measuring optimal wellbeing

Consensus that optimal wellbeing comprises hedonic and eudaimonic components has resulted in the development of new instruments to measure optimal wellbeing.^{17; 18; 19; 20; 155} However, development of these optimal wellbeing measures has been haphazard^{18; 156} with varying components and arbitrary thresholds used.^{19; 62} A recent review shows four-scales to assess optimal wellbeing have been developed, to date.⁶² These measures of optimal wellbeing include Keyes'^{19; 157} Mental Health Continuum (40- and 14-items scales), Diener et al.'s¹⁷ 8-item Flourishing Scale, Butler and Kern's¹⁵⁵ 23-item PERMA-profiler, and Huppert and So's¹⁸ 10-item flourishing scale (Table 4).

Table 4. Operationalisations of optimal wellbeing, from Hone et al.⁶²

Keyes, 2002¹⁹ & 2005¹⁵⁷	Diener et al., 2010¹⁷	Seligman, 2012²⁰ & Butler and Kern, 2015¹⁵⁵	Huppert and So, 2013¹⁸
<i>Categorical assessment 40- and 14-items</i>	<i>Continuous assessment 8-items</i>	<i>Categorical assessment 23-items</i>	<i>Categorical assessment 10-items</i>
Positive relationships	Positive relationships	Positive relationships	Positive relationships
Engagement	Engagement	Engagement	Engagement
Purpose in life	Purpose and Meaning	Meaning and purpose	Meaning
Self-acceptance	Self-acceptance and self-esteem	—	Self-esteem
Positive affect	—	Positive emotion	Positive emotion
—	Competence	Accomplishment/Competence	Competence
—	Optimism	—	Optimism
Social contribution	Social contribution	—	—
Social integration	—	—	—
Social growth	—	—	—
Social acceptance	—	—	—
Social coherence	—	—	—
Environmental mastery	—	—	—
Personal growth	—	—	—
Autonomy	—	—	—
Life satisfaction	—	—	—
—	—	—	Emotional stability
—	—	—	Vitality
—	—	—	Resilience

Similarities are evident across the four-scales (Table 4). All the scales comprise measures of positive relationships, engagement, and meaning and/or purpose. Table 4 also shows that self-esteem/self-acceptance, positive emotion, competence, optimism, and social contribution are common measures. Both Keyes' and Huppert and So's scales comprise additional measures. Keyes additional items primarily concentrate on social wellbeing, whilst Huppert and So assess vitality, emotional stability, and resilience.

Strengths and limitations of optimal wellbeing measures

Establishing a comprehensive understanding of the epidemiology of optimal wellbeing, including prevalence and influencing factors, is important in a positive health framework. Wellbeing scientists are now advocating for the inclusion of optimal wellbeing measures in epidemiological surveys. However, there remains a lack of agreement on the conceptualisations and operational definitions of optimal wellbeing that should be used to inform research and policy.^{18; 62}

Although valid and reliable, Diener et al.'s¹⁷ scale is not suitable for establishing the prevalence of optimal wellbeing. The 8-item Flourishing Scale only allows mean levels of optimal wellbeing to be calculated. Despite frequent citations in the literature, Butler and Kern's¹⁵⁵ PERMA-Profiler lacks empirical evidence to substantiate its robustness. Whilst Butler and Kern suggest their scale has been validated and tested, conclusions cannot be adequately drawn without insight into the methodologies used.

Keyes'^{19; 157} and Huppert and So's¹⁸ instruments both comprise categorical measures, enabling the prevalence of optimal wellbeing to be determined. Although unintentional, most items in Keyes scales mirror symptoms of the Diagnostic and Statistical Manual of Mental Disorders.¹⁵⁸ In contrast to Keyes, Huppert and So intentionally and systematically examined the mirror-opposite of each symptom of the diagnostic criteria for depression (DSM-IV) and anxiety (ICD-10) to identify features to include in their scale. Consequently, Huppert and So exclude some features assessed by Keyes, such as autonomy that do not reflect the mirror opposite to depression or anxiety. Nevertheless, similar to the diagnostic for depression (DSM-IV), to meet the criteria optimal wellbeing both scales require the endorsement of most of the features assessed, but not all. A strength of Huppert and So's¹⁸ scale is that it was developed and tested using data of a large, culturally diverse sample comprising 43,000 individuals, from 22 European countries. Future studies employing Huppert and So's scale therefore have the advantage of comparing prevalence rates of optimal wellbeing to 22 European nations.

Epidemiology of optimal wellbeing

Epidemiology generally explores the distribution of disease and factors influencing disease distribution within the population.¹⁵⁹ However, to develop a comprehensive understanding of positive health, exploring the epidemiology of wellbeing is also pertinent. Until recently,

wellbeing epidemiology has been restricted to assessments of life satisfaction and happiness.^{18;}
^{147; 160} Nevertheless, an important finding to emerge from the optimal wellbeing literature is that assessments of life satisfaction and happiness only show small to moderate correlations with emerging multi-dimensional measures of optimal wellbeing.^{17; 18} Establishing the prevalence of optimal wellbeing is helpful for developing and evaluating wellbeing policy.^{161; 162} In addition, exploring the characteristics and behaviours associated with optimal wellbeing is useful for identifying the most pertinent behaviours to target in intervention studies.

International research

Prevalence of optimal wellbeing

The small number of international studies that have explored the prevalence of optimal wellbeing show substantial variation between countries. In the largest study of optimal wellbeing to date, using their scale Huppert and So¹⁸ report a four-fold difference in the prevalence of optimal wellbeing between the lowest (Russia and Portugal <10%) and highest (Denmark 41%) ranked countries. Prevalence of optimal wellbeing for the Netherlands (37%)¹⁵⁴ and America (17%)¹⁹ have also been calculated (using Keyes scales^{19; 157}) and reported elsewhere. Although few studies have assessed optimal wellbeing, what is clear from those that have is that a large proportion of the population are falling short of the criteria. These findings indicate that promoting optimal wellbeing should be an increased priority.

Factors associated with optimal wellbeing

Studies investigating the characteristics and behaviours associated with high levels of optimal wellbeing are limited and findings are inconsistent among those that have. Schotanus-Dijkstra et al.¹⁵⁴ show in a national sample of Dutch adults ($n=5,303$) those meeting Keyes optimal wellbeing criteria are more likely to be young, female, higher educated, and in paid employment.¹⁵⁴ Those in the optimal wellbeing group were also less likely to be living alone.¹⁵⁴ Likewise, in a sample of American adults ($n=3,032$) Keyes¹⁹ found those who were married and more educated were more likely to reach the criteria for optimal wellbeing. However, in contrast to Schotanus-Dijkstra's¹⁵⁴ findings, Keyes¹⁹ shows males and older adults are more likely to be in the optimal wellbeing group. In a more recent study ($n=3,032$), Keyes shows smokers and

those who are inactive were less likely to achieve the criteria for optimal wellbeing.¹⁶³ However, research investigating the relationship between other lifestyle behaviours and optimal wellbeing is limited.

Optimal wellbeing in New Zealand

A small evidence-base is accruing on optimal wellbeing in New Zealand. Hone et al.¹⁶⁴ used the 8-item flourishing scale to compare mean scores between those that do and do not strongly endorse five behaviours in a large sample ($N=9,646$). Their findings show mean scores were significantly higher for those strongly endorsing Connecting, Giving, Taking notice, Keep learning, and Be active. In a more recent study, the same group of authors compared and contrasted four conceptualisations of optimal wellbeing. Whilst not the objective of the study, they show optimal wellbeing scores in New Zealand range from 24% to 47% depending on the operationalisation employed.⁶² In a recent study of young adults ($n=405$, mean age=19.9 years), nutrition variables and flourishing scores (Diener's 8-item) were assessed daily, over 13-consecutive days.¹⁶⁵ Increased fruit and vegetable consumption was positively associated with flourishing scores, whilst chip consumption was associated with decreased flourishing scores.¹⁶⁵ Whilst this research in New Zealand provides a starting point, to gain deeper insights into the characteristics and behaviours associated with optimal wellbeing, further research assessing diverse behaviours and in large and diverse samples is needed.

At a national level the New Zealand Health Survey is implemented by the Ministry of Health to collect annual data on the "health and wellbeing of New Zealanders".¹⁶⁶ However, the New Zealand Health Survey remains fundamentally deficit based. Psychological illness is primarily assessed and the four positively phrased mental health items provide inadequate assessments of optimal wellbeing (*How much of the time during the past four weeks...have you been happy, ...did you have a lot of energy, ...have you felt calm and peaceful, ...did you feel full of life*).¹⁶⁷

A second national survey, the New Zealand General Social Survey, is implemented by Statistics New Zealand to provide information on the social and economic wellbeing of New Zealanders.¹⁶⁸ Whilst the survey encompasses broader metrics of wellbeing, including social connections and meaning and purpose, than the New Zealand Health Survey,¹⁶⁹ the outcome metric is life satisfaction. Furthermore, a drawback of the New Zealand Social Survey is that it is

beyond the scope of the survey to collect lifestyle behaviour data. Thus, there are currently no national surveys in New Zealand that simultaneously collect data on physical, mental, and social wellbeing. In order to develop a comprehensive understanding of optimal wellbeing and positive health, epidemiological research incorporating assessments of optimal wellbeing are needed.

Promoting optimal wellbeing

A broad range of positive psychology interventions are emerging in the literature. To promote optimal wellbeing, it would be useful to explore the strategies employed thus far. In addition, it is useful to understand the types of messages most likely to resonate with the public.

Positive psychology interventions

Positive psychology interventions emphasise intentional activities and exercises for improving positive feelings, positive cognitions, or positive behaviours.²⁵ Activities and exercises include gratitude exercises, mindfulness exercises, positive writing, rehearsing positive statements, strengths exercises, and hope therapy.^{21; 23; 25} Findings from two meta-analyses provide evidence to support the efficacy of positive psychology interventions.^{21; 25} For example, in their review of 49 ($n=4,235$) studies, Sin and Lyubomirsky²⁵ show positive psychology interventions significantly increase wellbeing and decrease depressive symptoms. Similar findings were reported in Bolier et al.'s²¹ more recent meta-analysis of 39 ($n=6,139$) intervention studies. However, whether positive psychology interventions can be implemented effectively into real-world settings to improve population-level wellbeing is less clear.

To promote wellbeing in real-world settings it is essential that wellbeing initiatives are engaging and acceptable to the public. However, low participation rates in positive psychology intervention studies have led researchers to question their acceptability.²³ In their review of 49 positive psychology intervention studies, Hone et al.²³ found less than half the studies included participation rates, and of those that did, participation rates were low (range: 5%-92%, mean: 43%). Furthermore, homogenous samples, difficulty recruiting from the general population, and the omission of non-participant information were among additional limitations identified with positive psychology interventions.²³ Similarly, Bolier et al.²¹ show efficacious interventions were more likely have an individual-level focus, rather than comprising group sessions or self-help strategies. In addition, the evidence suggests positive psychology interventions yield better

outcomes for those referred via the healthcare system.²¹ Together these findings indicate positive psychology interventions might have better application in clinical, rather than population settings.

Population-level wellbeing initiatives

Despite the Mental Health Foundation of New Zealand's vision "for a society where all people flourish",¹⁷⁰ population-level initiatives are predominantly deficit based. More recently, however, the Mental Health Foundation has adopted the *Five Ways to Wellbeing* as an initiative. The *Five Ways to Wellbeing* comprise a set of five evidence-based messages developed by the United Kingdom's New Economics Foundation (Figure 5).^{65; 171} The *Five Ways to Wellbeing* emphasise important dimensions of optimal wellbeing including social connections and relationships (Connect); participation in social and community life (Give); continuation of learning and trying new things (Learn); mindfulness, savouring, and reflection (Take Notice); and physical activity (Be Active).⁶⁵



Figure 5. Five Ways to Wellbeing
Mental Health Foundation¹⁷²

A fundamental aim of the *Five Ways to Wellbeing* was "to establish a generic set of actions that has wide-ranging appeal" (p. 3).⁶⁵ To achieve this aim, several strategies were employed during the development phase.⁶⁵ Firstly, a list of wellbeing actions were identified from an extensive review of the wellbeing and positive psychology literature. Following the review, expert interviews helped to refine the list and communication experts drafted a set of messages.

Finally, consultation with mental health practitioners took place and their feedback was considered. However, the methodological report provides no indication that public feedback was sought.

Raising awareness and encouraging the public to adopt behaviours and actions to improve their wellbeing, depends on the ability to engage them. To develop successful initiatives, behaviour change theory suggests involving the intended audience in identifying priority behaviours for change.^{173; 174} If individuals do not perceive there to be value in changing a behaviour, then the success of action-oriented messages will be limited.^{173; 174} Whilst not to dismiss the *Five Ways to Wellbeing*, future research should consider involving the public to ensure wellbeing messages are suitable, appealing, and target priority behaviours for change.

What do the public want?

A limitation of the positive psychology literature is that limited attention has been given to identifying components of wellbeing that are important to the public. In a recent study, a prototype analysis was used to explore laypersons definitions of optimal wellbeing.¹⁷⁵ This study found that engaging in healthy lifestyle behaviours were key to how public defined their wellbeing. The findings also highlighted the concomitant role of lifestyle behaviours (including healthy eating, physical activity, and sleep), social relationships, and personal interests.¹⁷⁵ Whilst messages within the *Five Ways to Wellbeing* promote social relationships (e.g., Connect, Give) and personal interests (e.g., Learn, Take Notice), Be Active is the single lifestyle behaviour considered.

The decision to exclude nutrition from the *Five Ways to Wellbeing* was based on three arguments: (1) causality between healthy eating and wellbeing is unclear; (2) healthy eating relies on external resources (e.g., money and access); and, (3) nutrition messages are considered less of priority as they are messaged to the public elsewhere.⁶⁵ Whilst healthy eating might rely on external resources, nutrition is fundamental for day-to-day living and underpins optimal health. There is also emerging evidence to provide support for a biological plausible relationship between nutrition and optimal wellbeing.⁶³ What is more, although nutrition messaging occurs elsewhere, the focus is on disease prevention. To guide the development of

interventions, identifying and promoting components of wellbeing that are important to individuals should be considered.

Public health

The World Health Organization describes public health as a discipline that focuses on both disease prevention and health promotion at the population-level.¹⁷⁶ The origins of public health began with disease treatment. However, in 1986 the Ottawa Charter for Health Promotion aimed to shift the focus from curative health, by creating a better balance between the treatment and promotion of health.^{56; 177} In the decades since the Ottawa Charter, there has been a significant shift from treatment to prevention (Figure 6). In New Zealand, this is exemplified through current initiatives targeting immunisation, screening, and chronic disease prevention. Nevertheless, there are few examples of public health initiatives in New Zealand that move beyond disease prevention to focus explicitly on health promotion (Figure 6). To promote positive health, it is necessary to make this shift.

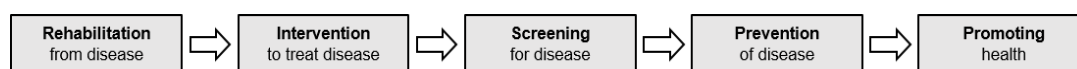


Figure 6. Stages of health care
Adapted from Guomundsdottir⁷

Promoting lifestyle behaviours

Among the areas targeted in public health are lifestyle behaviours. There is now substantial evidence to support the benefits of engaging in healthy lifestyle behaviours for health.^{27; 28; 29; 30} In addition, the hormetic model of wellbeing indicates lifestyle behaviours are likely to have benefits for wellbeing. It is therefore concerning to observe that in New Zealand, the proportion of individuals engaging in healthy lifestyle behaviours is declining.^{178; 179} Comparisons between findings from the 2014/15 New Zealand Health Survey, to the 2011/12 survey, show decreases in vegetable intake, fruit intake, and physical activity.^{178; 179} In contrast, physical inactivity and obesity have increased.^{178; 179}

Nutrition and physical activity

In an effort to encourage the public to adopt healthy eating and activity behaviours, national nutrition and physical activity guidelines have been in place for many years.^{180; 181} Although in many countries nutrition and physical activity guidelines are disseminated directly to the public, New Zealand guidelines are primarily developed for health professionals in the health sector.¹⁸² This raises concerns as the health sector predominantly targets individuals most at risk for poor health, thereby limiting the reach of guideline messages.

Reduced funding for translating and promoting nutrition and physical activity messages compounds the limited reach of nutrition and physical activity messages. Funding for population messages has declined substantially since the cessation of the Healthy Eating-Healthy Action strategic framework under a political right government. To align with the Ministry of Health's objective of promoting health and wellbeing for all New Zealanders,² it is important to encourage individuals who are not currently at health risk to maintain and engage in healthy lifestyles.

Physical activity

The 2001 Physical Activity Guidelines for New Zealand adults have informed previous and current physical activity initiatives (e.g., Push Play).¹⁸¹ These guidelines recommend 30-minutes of moderate-intensity physical activity on most days.¹⁸¹ However, New Zealand's guidelines have lagged behind the evidence which shows a curvilinear relationship between the dose and benefits of physical activity.¹⁸³ Brown et al.¹⁸⁴ note until recently public health messages have largely ignored the benefits of physical activity at the lower end of the intensity spectrum. On the other hand, increasing the duration and/or intensity of physical activity beyond the recommended guidelines may confer extra benefits.¹⁸³ Nevertheless, Brown et al. observe that the current physical activity guidelines (30-minutes on most days) has been set by public health as a "realistic behavioural target for the general population".¹⁸⁴ Despite this, research in New Zealand investigating whether the current message promoting 30-minutes of physical activity per day is acceptable to the public is scant.

Time is one of most frequently cited reasons for being inactive.¹⁸⁵ The magnitude of a quantifiable time in public health guidelines may exacerbate the reluctance to exercise among

time-poor or inactive individuals.¹⁸⁶ Developing insights into messages that appeal to laypersons is important. In addition, whilst encouraging inactive people to do something is important, equally important is encouraging those already active to increase intensity or duration for further benefits. The concept of hormesis suggests that for adaptation to occur, sufficient levels of exercise-induced stress are required.¹¹⁰

Sedentary behaviour

Knowledge of sedentary behaviour has substantially increased over the last decade. Sedentary behaviour is defined as “any waking behaviour characterized by an energy expenditure ≤ 1.5 METs while in a sitting or reclining posture” (p. 540).¹⁸⁷ Findings from a recent meta-analysis show breaks in sedentary time elicit favourable changes in blood glucose, blood insulin levels, and inflammatory markers.¹⁸⁸ In addition, the hormetic model indicates sedentary behaviour is likely to be inversely associated with wellbeing. Nevertheless, empirical evidence investigating this association is limited.

Nutrition

Similar to physical activity, the 2003 Food and Nutrition Guidelines for New Zealand adults have informed previous and current nutrition initiatives.¹⁸⁹ These guidelines emphasise fruit and vegetable consumption, breads and cereals, and milk and milk products. In addition, the guidelines recommend foods low in salt, sugar, and fat. Low fat messaging has been the predominant focus in public health over the last decade. In New Zealand, for example, the Heart Foundation Tick is displayed on products lower in saturated fat, trans fat, sodium, and kilojoules.¹⁹⁰ However, more recently the adverse effects of sugar have received increased attention. The World Health Organization have released the first guidelines for sugar intake in response to compelling evidence to show associations between sugar and poor health outcomes.¹⁹¹ In addition, there is accumulating evidence to support the benefits of diets rich in unprocessed foods including fruit and vegetables, nuts, fish, seeds, and dairy, and low in sugar, processed foods, and alcohol.¹⁹²

Sleep

In contrast to nutrition and physical activity, public health has given surprisingly little attention to sleep.^{193; 194} Nevertheless, there is compelling evidence to show sufficient sleep—defined as adequate sleep quality and duration—is important for maintaining optimal health.^{136; 137; 195; 196} In addition, the hormetic model of wellbeing indicates sleep is also likely to be important for optimal wellbeing. Experimental studies in humans show sleep plays a role in the regulation of insulin,^{136; 137} leptin levels,¹⁹⁵ inflammatory markers,¹⁹⁷ and the hypothalamic-pituitary-adrenal axis.¹⁹⁶ Although sufficient sleep is necessary for healthy and productive lifestyles,²⁹ international evidence suggests the incidence of insufficient sleep is rising.¹⁹⁸ Promoting strategies to improve sleep is likely to be important in a framework for positive health.

The behaviours known to influence sleep are screen-time,^{199; 200} caffeine²⁰¹ and alcohol²⁰² consumption, exercise,²⁰³ and sunlight.¹⁹⁴ The effects of screen-time are particularly pertinent to consider in modern technology driven environments. Screen-time may not only be displacing sleep,²⁹ but there is also emerging research that shows using light emitting devices prior to bed increases evening alertness, delays sleep onset, and reduces next day alertness.^{199; 200} Similarly, there is substantial evidence to show alcohol²⁰² and caffeine²⁰¹ consumption reduce sleep quality. In contrast, exercise²⁰³ and sunlight¹⁹⁴ during the day are associated with improved sleep quality. Ensuring consistency in sleep and wake times is also important for sleep quality.¹⁹⁴ Research shows an inverted U-shaped association between sleep duration and health outcomes, with 7-9 hours' sleep per night associated with lower risks of morbidity and mortality.²⁹ Concerted efforts are needed to raise awareness of the importance of sufficient sleep.

Multiple lifestyle behaviour change

In public health, lifestyle behaviours are mostly studied and promoted in isolation. In real-world settings, however, lifestyle behaviours do not occur independently.³¹ There is evidence to show unhealthy lifestyle behaviours—including physical inactivity, poor nutrition, alcohol, and smoking—cluster together.^{204; 205; 206} There is also evidence to suggest multiple unhealthy lifestyle behaviours synergistically affect morbidity and mortality.²⁰⁷ Similarly, the hormetic model of wellbeing suggests multiple lifestyle behaviours are likely to have concurrent positive

or negative effects on the biological correlates underpinning optimal wellbeing. From a positive health perspective, it therefore seems prudent to consider and explore the utility of promoting multiple lifestyle behaviours concurrently.

Despite the few examples of population messages that promote multiple lifestyle behaviours, concurrently, there is a small body of research that indicates targeting multiple lifestyle behaviours simultaneously is promising.³² Benefits of multiple behaviour change interventions have been identified at both the individual- and population-levels.³³ For individuals, successfully improving one or more lifestyle behaviours may lead to the confidence and self-efficacy to improve others.³³ At the population level, there is evidence to suggest that targeting multiple behaviours concurrently is likely to be both efficient and cost-effective.³³

Laypersons perspectives

“Acknowledge people as the main health resource.... accept the community as the essential voice in matters of its health, living conditions and well-being”, Ottawa Charter for Health Promotion, 1987.⁵⁶

Research within a positive health framework should focus on developing a clearer understanding of how the public would like lifestyle behaviours to be promoted. In the Ottawa Charter for Health Promotion, people and the community are acknowledged as a central resource.⁵⁶ However, in New Zealand the promotion of lifestyle behaviours is guided primarily by expert consensus, with limited involvement from the public sought. Participatory models are important for developing comprehensive insights into the needs of individuals and communities. In addition, behaviour change theory consistently recommends involving the intended audience to develop sustainable interventions.^{173; 174}

Chapter summary

Although positive psychology and public health each make contributions toward understanding and promoting positive health, there are few examples of research integrating these disciplines. Thus, despite the potential benefits of shifting the population toward positive health, significant gaps in knowledge currently exist.

In shifting toward a focus on wellbeing, positive psychology has paved the way in challenging the assumptions of a deficit model. In doing so, the discipline of positive psychology provides a broader perspective of optimal wellbeing. There is increasing evidence to support the notion that optimal wellbeing is a multi-dimensional construct comprising both positive feelings and positive functioning. Thus, research and practice within a positive health framework needs to extend beyond traditional measures of life satisfaction and happiness.

In countries where the prevalence of optimal wellbeing has been measured, most of the population are failing to achieve the criteria for optimal wellbeing. This finding indicates that not only is a more comprehensive understanding of the conditions that support optimal wellbeing needed, but so too are explicit efforts to promote optimal wellbeing. Nevertheless, relatively little is understood about the conditions and behaviours that support optimal wellbeing. In light of emerging evidence to indicate the relationship between lifestyle behaviours and optimal wellbeing are biologically plausible, epidemiological research should assess this relationship as a starting point. Examining the literature indicates that positive psychology interventions are efficacious in clinical settings. However, how to translate the promotion of optimal wellbeing into real-world population-level settings is unclear.

Public health is a discipline that adopts a whole-of-population focus. Although public health has focused on promoting lifestyle behaviours at the population level, this is done to prevent health risk. Under a hormetic model, tailored initiatives might be more appropriate for promoting optimal wellbeing than generic one-size-fits all approaches. In addition, the hormetic model of wellbeing indicates promoting multiple lifestyle behaviours, concurrently, should be considered. Further research is needed to investigate the application of lifestyle behaviours in a framework for positive health.

Chapter 3

Associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults

Preface

Engaging in healthy lifestyle behaviours is likely to play a significant role in achieving positive health. There is a substantial body of research to show that lifestyle behaviours are associated with optimal health. However, a review of the literature (Chapter 2) shows knowledge of the relationships between lifestyle behaviours and multi-dimensional measures of optimal wellbeing are unclear. Until now, life satisfaction measures have comprised the predominant wellbeing outcome in epidemiological research. However, these measures have been criticised for failing to capture important dimensions of eudaimonic wellbeing, such as social relationships and meaning and purpose. A better understanding of the prevalence and associations between lifestyle behaviours and optimal wellbeing will provide a useful step in guiding research within a framework for positive health.

In the current chapter, associations between lifestyle behaviours and a multi-dimensional measure of optimal wellbeing are explored in a large and diverse sample of New Zealand adults. The findings of this chapter contribute to the limited wellbeing research in New Zealand and the wider wellbeing epidemiology field to show for the first time that lifestyle behaviours are associated with a broad multi-dimensional measure of optimal wellbeing. Although the relationship between lifestyle behaviours and optimal wellbeing may be bidirectional, the study provides the rationale for investigating lifestyle initiatives for promoting positive health.

The manuscript resulting from this chapter has been published by the peer-reviewed journal, BMC Public Health. Data for this study were analysed by the candidate (KP).

Abstract

Background. In positive psychology, optimal wellbeing is considered a broad, multi-dimensional construct encompassing both feelings and functioning. Yet, this notion of wellbeing has not been translated into public health.

Aim. The purpose of this study is to integrate public health and positive psychology to determine associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults.

Methods. A web-based survey design was employed to collect data. Participants reported on their wellbeing and lifestyle behaviours including nutrition, exercise, sedentary behaviour, and sleep. Optimal wellbeing was calculated using a multi-dimensional scale designed to mirror the internationally recognised diagnostic criteria for mental disorders. Binary logistic regression was used to calculate associations between 10 lifestyle behaviours and optimal wellbeing.

Results. Of the total sample ($n=9,514$), 24% met the criteria for optimal wellbeing. Compared with reference groups, the association with optimal wellbeing was greater for those who reported exercising ≥ 7 times/week (odds ratio: 1.61, 95% confidence interval: 1.22-2.13, $p<0.01$) and sitting “almost none of the time” (1.87, 1.01-3.29, $p<0.01$). Optimal wellbeing was lower for those reporting restless sleep “almost all of the time” (0.24, 95% CI: 0.17-0.32 $p<0.01$) and those consuming sugary drinks 5-6 times/week (0.73, 95% CI: 0.53-0.95, $p<0.05$).

Conclusions. Public health and positive psychology were integrated to provide support for a relationship between lifestyle behaviours and a multi-dimensional measure of optimal wellbeing. It is likely this relationship between lifestyle behaviours and optimal wellbeing is bidirectional giving rise to the debate that holistic approaches are needed to promote positive health.

Introduction

In 1946 the World Health Organization defined health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (p. 1315).¹ From this definition the notion of positive health, where health is considered beyond the absence of disease, emerged.^{3; 14; 208} However, this concept of positive health remains somewhat elusive³ as epidemiological work and public health guidelines continue to focus on preventing and restoring negative functioning rather than promoting positive health. In contrast to understanding pathology, far less is known about the behaviours and characteristics associated with positive health and optimal wellbeing.

Recognition that a fundamental shift was needed to study wellbeing in its own right has led to the emergence of the positive psychology field.^{16; 18} Within positive psychology, a broader, more complex notion of wellbeing has emerged.^{17; 19; 20; 64} Optimal wellbeing—or flourishing as it is also referred—is considered a multi-dimensional construct incorporating both hedonic (e.g., positive emotion, life satisfaction, and happiness) and eudaimonic (e.g., meaning and purpose, positive relationships, and engagement) aspects of wellbeing.^{17; 18; 19; 20} There is now agreement that multi-dimensional measures of optimal wellbeing, which take into account hedonic and eudaimonic aspects of wellbeing, should be used to determine and characterise those individuals with the highest levels of wellbeing.^{17; 18}

Only recently have multi-dimensional measures of optimal wellbeing emerged which can be used to categorically determine those with the highest levels of wellbeing.^{18; 19} In the largest wellbeing study to date, Huppert and So developed and tested a categorical measure of optimal wellbeing using a representative sample of 43,000 individuals from 22 European countries.¹⁸ This measure of optimal wellbeing was developed using a conceptual framework specifically designed to mirror the internationally agreed methodology used to diagnose mental disorders.¹⁸ Through a systematic examination of the symptoms of common mental disorders, generalised anxiety (ICD-10) and depression (DSM-IV), ten features representing optimal mental health were identified: happiness, vitality, optimism, resilience, self-esteem, emotional stability, engagement, meaning, competence, and positive relationships. Factor analysis, inter-item correlations, and data distribution indicated that optimal wellbeing required the presence of three factors: positive emotion (comprising happiness); positive characteristics (vitality,

optimism, resilience, self-esteem, emotional stability); and positive functioning (engagement, meaning, competence, positive relationships). To be classified as having optimal wellbeing individuals are required to meet the criteria for positive emotion, four out of five features of positive characteristics, and three out of four features of positive functioning. This method of classifying the presence of optimal wellbeing is similar to that used to classify major depressive disorders where the presence of most, but not all, features are required.

Positive psychologists recognise that there is a need to identify characteristics and behaviours that are associated with optimal wellbeing.^{17; 18} Nonetheless, research thus far has been limited to examining socio-demographic factors such as age, gender, ethnicity, and household income.^{19; 154} It does however, seem plausible that prudent lifestyle behaviours, such as healthy eating, adequate sleep, physical activity, avoiding tobacco, and constraining alcohol consumption, may be associated with optimal wellbeing. Whilst lifestyle behaviours have been extensively examined in public health, research investigating associations between lifestyle behaviours and wellbeing have typically relied on single item measures of life satisfaction or happiness.^{50; 51; 179} However, findings from previous studies show these single item measures only have small to moderate correlations with multi-dimensional measures of optimal wellbeing.¹⁸

At an epidemiological level, an integrative approach to understanding associations between lifestyle behaviours and optimal wellbeing is needed. If associated, promoting lifestyle behaviours may provide an opportunity for increasing wellbeing, or vice versa. Identifying lifestyle behaviours that are associated with optimal wellbeing will provide a useful step in guiding future research and interventions aimed at promoting positive health. The purpose of this study is to integrate measures from public health and positive psychology to determine (1) the proportion of a large, demographically diverse sample of New Zealand adults meeting the criteria for optimal wellbeing and (2) associations between lifestyle behaviours and optimal wellbeing. This study will contribute to the limited research on lifestyle behaviours and multi-dimensional measures of optimal wellbeing.

Methods

Data for this cross-sectional study were obtained from the Sovereign Wellbeing Index (Round 1); a survey on the health and wellbeing of a large, demographically diverse sample of New Zealand adults.²⁰⁹ A web-based survey design was employed to collect data during September and October 2012. Ethical approval to conduct the study was granted by the Auckland University of Technology Ethics Committee on 23 August 2012 (AUTEC: 12/201).

The web-based survey design was chosen as it offered a number of advantages over traditional data collection modes (i.e., door-to-door or computer assisted telephone interviews). These advantages include the relative cost-effectiveness of the approach, the ability to overcome geographical constraints, and the minimisation of errors associated with data entry.²¹⁰ Recent reports indicate the proportion of New Zealand households with access to the internet (80%) and landline telephones (85%) is similar.^{211; 212}

Participants

A commercial market research company (TNS Global, New Zealand office) was contracted to administer the web-based survey. Participants were recruited from the SmileCity database; the largest commercially available database in New Zealand. The database comprises 247,675 active members recruited through both offline (51%) and online (49%) sources.²¹³

The target sample size for the current study was 10,000 participants. The sample size was determined partly by financial constraints, and partly to obtain a reasonable precision of estimates. Eligible individuals included SmileCity database members aged over 18 years who had not participated in a survey within the last 7-days. There were no further exclusion criteria.

Email invites—with a link to the survey—were sent to 38,439 individuals randomly selected from the 229,032 eligible individuals. The survey was open to potential participants for 7-days. No follow-up invites were sent to individuals who did not complete the survey within the specified timeframe. All participants provided informed consent prior to entering the survey.

Variables

The web-based survey included 134 questions on wellbeing, health and lifestyle, and socio-demographics. To enable international and national comparisons, the wellbeing component primarily comprised questions drawn from the European Social Survey (Round 6)²¹⁴ whilst the health and lifestyle component comprised questions primarily from the New Zealand Health Survey (2006).²¹⁵ Measures specific to the current study only are discussed in detail below.

Optimal wellbeing. Optimal wellbeing was treated as a binary variable. The ten items (refer to Table 5) to measure optimal wellbeing were drawn from the European Social Survey (Round 6).²¹⁴ A modified version of Huppert and So's scale, reflecting changes made to two items between Rounds 3 and 6 of the European Social Survey, was used to calculate optimal wellbeing.^{18; 62; 216} These two items which differed from the original scale were '*I love learning new things*' and '*There are people in my life who really care about me*'. The items were replaced with '*To what extent do you learn new things in your life*' and '*To what extent do you receive help and support from people you are close to when you need it*', respectively.^{62; 216} Hone et al. recently demonstrated moderate to strong agreement between the modified version of Huppert and So's measure and other measures of optimal wellbeing.⁶²

The ten items used to measure optimal wellbeing combined both hedonic (feelings) and eudaimonic (functioning) aspects of wellbeing.¹⁸ The items were rated on 4-point to 11-point Likert scales. All items were phrased in a positive direction except for the item measuring resilience, which was reverse coded. Optimal wellbeing was determined as meeting the thresholds for positive emotion (*happiness* ≥ 8); and four out of five features of positive characteristics (*vitality* ≥ 3 , *optimism* ≥ 4 , *resilience* ≥ 4 , *self-esteem* ≥ 4 , *emotional stability* ≥ 2); and three out of four features of positive functioning (*engagement* ≥ 5 , *meaning* ≥ 4 , *competence* ≥ 4 , *positive relationships* ≥ 4).^{18; 62} Table 5 provides a summary of the constructs, features, items, and thresholds used to calculate optimal wellbeing.

Table 5. Constructs, features, items and thresholds used to calculate optimal wellbeing

Construct and features	Item (Likert scale; anchors)	Threshold
Positive emotion (required)		
Happiness	Taking all things together, how happy would you say you are? <i>0-10; extremely unhappy-extremely happy</i>	≥ 8
Positive characteristics (4 of 5 required)		
Emotional stability	In the past week, I felt calm and peaceful <i>1-4; none or almost none of the time-all or almost all of the time</i>	≥ 2
Vitality	During the past week, you had a lot of energy? <i>1-4; none or almost none of the time-all or almost all</i>	≥ 3
Optimism	I am always optimistic about my future <i>1-5; strongly disagree-strongly agree</i>	≥ 4
Resilience	When things go wrong in my life it generally takes me a long time to get back to normal <i>1-5; strongly disagree-strongly agree; reverse score</i>	≥ 4
Self-esteem	In general, I feel very positive about myself <i>1-5; strongly disagree-strongly agree</i>	≥ 4
Positive functioning (3 of 4 required)		
Engagement	To what extent do you learn new things in your life? <i>0-6; not at all-a great deal</i>	≥ 5
Competence	Most days I feel a sense of accomplishment from what I do <i>1-5; strongly disagree-strongly agree</i>	≥ 4
Meaning	I generally feel that what I do in my life is valuable and worthwhile <i>1-5; strongly disagree-strongly agree</i>	≥ 4
Positive relationships	To what extent do you receive help and support from people you are close to when you need it? <i>0-6; not at all-completely</i>	≥ 4

To be classified as meeting the criteria for optimal wellbeing individuals must (1) meet the threshold for positive emotion; (2) meet the threshold for four out of five features of positive characteristics; and (3) meet the threshold for three out of four features of positive functioning.

Socio-demographic variables. Self-reported socio-demographic variables including gender, date of birth, ethnicity, and household income were collected as part of the web-based survey. In accordance with Statistics New Zealand's Statistical Standard for Ethnicity, respondents were provided with the option of selecting multiple ethnic response categories.²¹⁷ Responses were coded into three independent categories (European/Other, Maori/Pacific, and Asian) using Statistics New Zealand Level 1 prioritised ethnic classifications.²¹⁷ Date of birth was used to calculate age with the survey start date as the reference. Continuous age was recoded into 10-yearly groupings according to Statistics New Zealand's Statistical Standard for Age.²¹⁸ Finally, household income was stratified into tertiles to reflect low (\leq \$40,000), moderate (\$40,000-\$90,000), and high (\geq \$90,001) incomes.

Lifestyle behaviours. Ten lifestyle behaviours were included in the analysis including breakfast consumption, sugary drink consumption, fruit intake, vegetable intake, smoking, alcohol consumption, exercise, sedentary behaviour, sleep quality, and body mass index (BMI).

Questions to measure breakfast consumption, sugary drink consumption, fruit intake, vegetable intake, smoking, and alcohol consumption were drawn from the New Zealand Health Survey (2006), an annual door-to-door survey conducted by the Ministry of Health.²¹⁵ Respondents were asked to indicate how many days during the past week they had breakfast (*never, 1-2 days, 3-4 days, 5-6 days, 7 days*); how often during the past week they drank sugary beverages (*I don't drink sugary drinks, less than once, 1-2 times, 3-4 times, 5-6 times, ≥7 times*); on average how many servings of fruit they had over the past week (*I don't eat fruit, <1 serving/day, 1 serving/day; 2 servings/day; 3 servings/day, ≥ 4 servings/day*); and on average how many servings of vegetables they had over the past week (*I don't eat vegetables, < 1 serving/day, 1 serving/day; 2 servings/day; 3 servings/day, ≥ 4 servings/day*).²¹⁵ For smoking, respondents were asked if they smoke cigarettes regularly (*yes, no*).²¹⁵ Alcohol consumption was assessed by asking respondents to indicate how often they have a drink containing alcohol (*I don't drink alcohol, monthly or less, up to four times/month, up to three times/week, ≥ 4 times/week*).²¹⁵

Exercise was measured using a single item exercise frequency question which asked participants to report how often during the past week they exercised (*I didn't exercise, 1-2 times, 3-4 times, 5-6 times, ≥ 7 times*).^{51; 219} Sedentary behaviour was measured using a single item sitting question.²²⁰ Response options were adapted from their original format (*never, seldom, sometimes, often, always*)²²⁰ to reflect the response scales used throughout the web-based survey (*none or almost none of the time, a little of the time, some of the time, most of the time, all or almost all of the time*).

Sleep quality was assessed using a question drawn from the European Social Survey (Round 6) Survey.²²¹ The question originates from the Center for Epidemiologic Studies Depression Scale¹⁴² and has been used to measure restless sleep elsewhere.^{222; 223} Respondents were asked to indicate how much of the time during the past week their sleep was restless (*none or almost none of the time, some of the time, most of the time, all or almost all of the time*).

Body mass index was derived using self-reported height and weight measures and was calculated as $\text{weight}_{\text{kg}} / (\text{height}_{\text{m}}^2)$. World Health Organization thresholds were used to categorise BMI as: underweight (≤ 18.4), normal weight (18.5-24.9), overweight (25.0-29.9), and obese (≥ 30.0).²²⁴

With the exception of BMI, all lifestyle variables are reported as per their original response scales.

Data analysis

Optimal wellbeing was treated as the dependent variable. Participants' data were, therefore, only included in the final analyses if a response was provided for each of the ten items used to calculate optimal wellbeing. Binary logistic regression analysis was used to determine associations between both demographic factors and lifestyle behaviours and optimal wellbeing (IBM SPSS Statistics version 19 for Windows). Crude, partially adjusted (adjusted for age, gender, ethnicity, and household income), and fully adjusted (adjusted for all socio-demographic and lifestyle variables concurrently) odds ratios were calculated. Bootstrapped 95% confidence intervals (CI) were calculated using 1,000 samples. The alpha was set at 0.05 to determine statistical significance. Missing data for lifestyle behaviours and socio-demographic variables were excluded pairwise.

Results

Participant characteristics

The return rate for the survey was 32% ($n=12,170$) and the completion rate was 82% ($n=9,962$) (Figure 7). Of those deemed to have completed the survey, data to calculate optimal wellbeing were available for 9,514 (47% male) participants. Sample characteristics for the current study are shown in Table 6.

The sample characteristics were compared with the estimated resident population in New Zealand during the June, 2012 to September, 2012 quarter.²²⁵ Our sample was slightly over-represented by those in the lowest household income tertile (33% vs. 32%) and slightly under-represented by males (47% vs. 49%) and those aged 40-49 years (17% vs. 19%), 50-59 years (16% vs. 18%), and over 60 years (23% vs. 26%). Comparing the final sample characteristics to those that did not respond to the survey invite indicated non-respondents were over-represented by males (47% vs. 51%), those aged 18-29 years (26% vs. 38%), and those aged 30-39 years (18% vs. 19%).

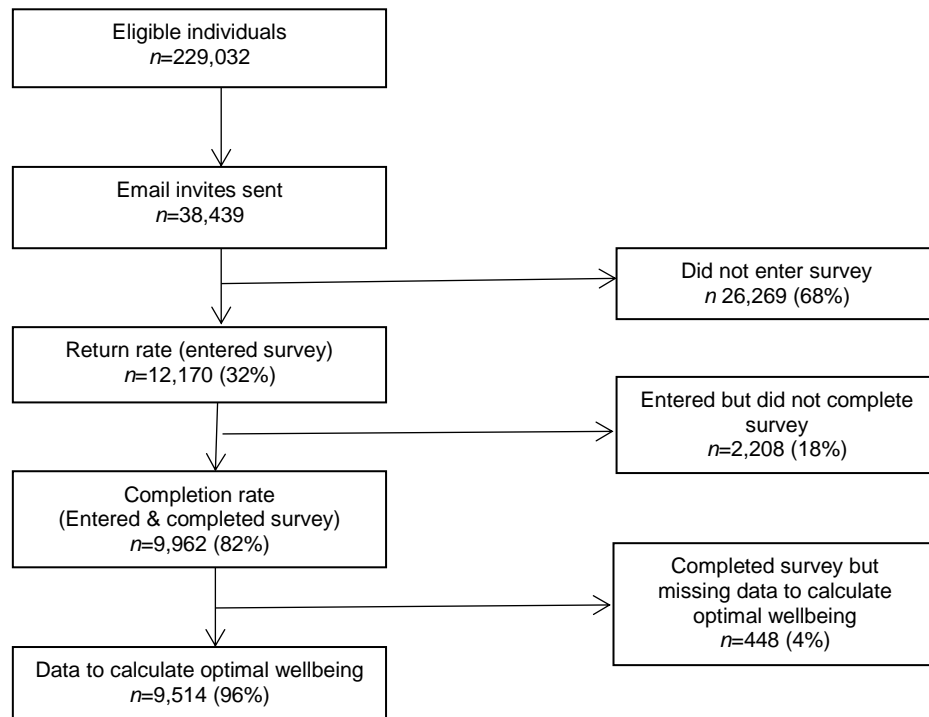


Figure 7. Flow diagram of participant recruitment

Table 6. Proportion of the sample meeting the criteria for optimal wellbeing (n=9,514)

	Total n (%)	Optimal wellbeing n (%; 95% CI)	Crude OR¹ (95% CI²)	Partially³ adjusted OR¹ (95% CI²)	Fully⁴ adjusted OR¹ (95% CI²)
Gender					
Male	4478 (47)	1101 (25, 23-26)	1.00	1.00	1.00
Female	5013 (53)	1199 (24, 23-25)	0.96 (0.88-1.06)	1.10 (0.98-1.23)	1.02 (0.88-1.18)
Age, years					
<20	221 (3)	41 (19, 13-24)	1.00	1.00	1.00
20-29	1856 (23)	359 (19, 18-21)	1.05 (0.75-1.56)	0.93 (0.60-1.59)	0.90 (0.55-1.50)
30-39	1472 (18)	305 (21, 19-23)	1.15 (0.82-1.75)	0.90 (0.57-1.53)	0.75 (0.46-1.27)
40-49	1413 (17)	303 (21, 19-24)	1.20 (0.85-1.82)	0.94 (0.59-1.62)	0.81 (0.50-1.42)
50-59	1326 (16)	336 (25, 23-28)	1.49 (1.06-2.21)*	1.23 (0.78-2.10)	0.98 (0.60-1.69)
60-69	1337 (16)	448 (34, 31-36)	2.21 (1.59-3.40)**	2.18 (1.40-3.69)**	1.43 (0.88-2.43)
70-79	495 (6)	198 (40, 36-44)	2.93 (2.03-4.39)**	3.36 (2.09-6.13)**	2.00 (1.16-3.51)*
≥80	54 (1)	17 (32, 19-44)	2.02 (0.94-3.92)*	1.91 (0.77-4.28)	1.19 (0.51-2.75)
Ethnicity					
European/Other	7093 (76)	1724 (24, 23-25)	1.00	1.00	1.00
Asian	1002 (11)	232 (23, 21-26)	0.94 (0.80-1.09)	1.26 (1.02-1.55)*	1.25 (0.97-1.59)
Maori/Pacific	1229 (13)	313 (26, 23-28)	1.06 (0.92-1.23)	1.20 (0.99-1.41)*	1.52 (1.23-1.89)**
Household income					
Low (≤ \$40,000)	2366 (33)	481 (20, 19-22)	1.00	1.00	1.00
Mid (\$40,001-\$90,000)	2510 (36)	582 (23, 22-25)	1.18 (1.04-1.36)*	1.46 (1.27-1.67)**	1.30 (1.10-1.56)**
High (≥ \$90,001)	2191 (31)	660 (30, 28-32)	1.69 (1.47-1.93)**	2.26 (1.93-2.61)**	1.84 (1.55-2.23)**
Restless sleep, how often past week					
None or almost none of the time	2182 (23)	754 (35, 33-37)	1.00	1.00	1.00
Sometimes	4397 (46)	1246 (28, 27-30)	0.75 (0.67-0.84)**	0.78 (0.68-0.89)**	0.83 (0.71-0.96)*
Most times	1915 (20)	217 (11, 10-13)	0.24 (0.20-0.29)**	0.27 (0.22-0.33)**	0.31 (0.24-0.39)**
All or almost all of the time	1009 (11)	84 (8, 7-10)	0.17 (0.13-0.22)**	0.20 (0.15-0.26)**	0.24 (0.17-0.32)**
Body mass index					
Normal weight	2660 (35)	645 (24, 23-26)	1.00	1.00	1.00
Underweight	148 (2)	28 (19, 13-25)	0.73 (0.46-1.08)	0.70 (0.39-1.14)	0.75 (0.37-1.30)
Overweight	2521 (33)	730 (29, 27-31)	1.27 (1.12-1.44)**	1.18 (1.01-1.38)*	1.24 (1.05-1.46)*
Obese	2375 (31)	491 (21, 19-22)	0.81 (0.71-0.93)**	0.75 (0.63-0.88)**	0.89 (0.74-1.07)
Alcohol, how often do you have a drink containing					
≤ 4 times/month	1707 (18)	450 (26, 24-28)	1.00	1.00	1.00
Never	2408 (26)	573 (24, 22-26)	0.87 (0.75-1.01)	0.83 (0.70-1.00)*	0.88 (0.71-1.08)
≤ 1 time/month	2858 (31)	595 (21, 19-22)	0.73 (0.64-0.85)**	0.72 (0.61-0.85)**	0.76 (0.62-0.92)**
≤ 3 times/week	1273 (14)	342 (27, 24-29)	1.03 (0.86-1.22)	0.88 (0.71-1.06)	0.90 (0.72-1.11)
≥ 4 times/week	1088 (12)	300 (28, 25-30)	1.06 (0.89-1.27)	0.79 (0.65-0.98)*	0.87 (0.68-1.08)
Regular smoker					
Yes	1642 (17)	291 (18, 16-20)	1.00	1.00	1.00
No	7779 (83)	1997 (26, 25-27)	1.60 (1.40-1.85)**	1.44 (1.23-1.72)**	1.18 (0.98-1.45)
Exercise, how many times past week					
Don't exercise	3379 (38)	614 (18, 17-19)	1.00	1.00	1.00
1-2 times/week	2552 (28)	612 (24, 22-26)	1.42 (1.24-1.62)**	1.46 (1.23-1.69)**	1.21 (1.02-1.43)*
3-4 times/week	1874 (21)	535 (29, 27-31)	1.80 (1.58-1.62)**	1.81 (1.52-2.13)**	1.39 (1.13-1.69)**
5-6 times/week	972 (11)	309 (32, 29-35)	2.10 (1.79-2.46)**	1.88 (1.56-2.29)**	1.37 (1.11-1.69)**
≥ 7 times/week	215 (2)	188 (37, 32-41)	2.59 (2.11-3.11)**	2.32 (1.78-3.10)**	1.61 (1.22-2.13)**

Sedentary levels, time spent sitting for the most part of each day past week

All or almost all of the time	651 (7)	99 (15, 12-18)	1.00	1.00	1.00
None or almost none of the time	192 (2)	53 (28, 21-34)	2.13 (1.42-3.23)**	2.28 (1.38-3.72)**	1.87 (1.01-3.29)**
A little of the time	1263 (13)	363 (29, 26-31)	2.25 (1.77-2.96)**	1.91 (1.42-2.37)**	1.68 (1.20-2.49)**
Some of the time	4177 (44)	1169 (28, 27-29)	2.17 (1.72-2.78)**	1.88 (1.46-2.60)**	1.59 (1.18-2.26)**
Most of the time	3151 (33)	598 (19, 18-20)	1.31 (1.03-1.68)*	1.16 (0.91-1.62)	1.09 (0.79-1.57)

Vegetables, average servings per day over last week

Don't eat vegetables	107 (1)	11 (10, 5-16)	1.00	1.00	1.00
<1 serving/day	859 (9)	115 (13, 11-16)	1.35 (0.77-2.99)	1.51 (0.68-7.07)	1.43 (0.58-7.14)
1 servings/day	2327 (25)	496 (21, 20-23)	2.36 (1.39-5.38)*	2.42 (1.13-11.89)*	1.75 (0.75-8.44)
2 servings/day	2432 (26)	577 (24, 22-25)	2.71 (1.58-6.09)**	3.01 (1.44-14.30)**	2.06 (0.86-10.17)
3 servings/day	2045 (22)	579 (28, 26-30)	3.45 (2.03-7.87)**	3.52 (1.62-16.79)**	2.21 (0.92-10.84)
≥4 servings/day	1563 (17)	502 (32, 30-34)	4.13 (2.42-9.27)**	4.22 (1.97-19.63)**	2.31 (0.97-11.54)

Fruit, average servings/day over last week

Don't eat fruit	323 (3)	42 (13, 9-17)	1.00	1.00	1.00
<1 serving/day	1931 (21)	301 (16, 14-17)	1.24 (0.89-1.825)	1.07 (0.72-1.67)	0.88 (0.55-1.46)
1 servings/day	2826 (30)	661 (23, 22-25)	2.04 (1.50-2.89)**	1.68 (1.17-2.74)*	1.06 (0.66-1.78)
2 servings/day	2489 (27)	696 (28, 26-30)	2.60 (1.89-3.79)**	2.06 (1.43-3.27)**	1.13 (0.71-1.88)
3 servings/day	1134 (12)	356 (31, 29-34)	3.06 (2.21-4.54)**	2.38 (1.64-3.96)**	1.28 (0.78-2.19)
≥4 servings/day	642 (7)	226 (35, 32-39)	3.63 (2.60-5.49)**	2.59 (1.68-4.20)**	1.35 (0.80-2.35)

Breakfast, how many days over last week

7 days/week	5255 (56)	1561 (30, 28-31)	1.00	1.00	1.00
Never	1060 (11)	153 (14, 12-17)	0.40 (0.33-0.47)**	0.50 (0.40-0.62)**	0.81 (0.62-1.08)
1-2 days/week	1116 (12)	178 (16, 14-18)	0.45 (0.37-0.53)**	0.54 (0.43-0.68)**	0.75 (0.58-0.93)*
3-4 days/week	943 (10)	196 (21, 18-23)	0.62 (0.52-0.73)**	0.80 (0.65-0.98)*	0.91 (0.71-1.17)
5-6 days/week	1020 (11)	200 (20, 17-22)	0.58 (0.49-0.67)**	0.60 (0.48-0.73)**	0.67 (0.52-0.84)**

Sugary drinks, how often over last week

Don't drink sugary drinks	2545 (27)	784 (31, 29-33)	1.00	1.00	1.00
<1 time/week	1516 (16)	389 (26, 23-28)	0.78 (0.68-0.90)**	0.83 (0.69-0.99)*	0.86 (0.70-1.06)
1-2 times/week	2340 (25)	534 (23, 21-25)	0.66 (0.58-0.75)**	0.77 (0.66-0.90)**	0.82 (0.67-1.00)
3-4 times/week	1366 (15)	283 (21, 19-23)	0.59 (0.51-0.68)**	0.72 (0.59-0.87)**	0.83 (0.66-1.03)
5-6 times/week	684 (7)	123 (18, 15-21)	0.49 (0.40-0.60)**	0.60 (0.46-0.78)**	0.73 (0.53-0.95)*
≥7 times/week	932 (10)	175 (19, 16-21)	0.52 (0.43-0.63)**	0.67 (0.54-0.85)**	0.92 (0.71-1.18)

* $p < 0.05$; ** $p < 0.01$; ¹odds ratio; ²bootstrapped 95% confidence interval; ³adjusted for gender, age, ethnicity, income; ⁴adjusted for all demographic and lifestyle behaviours concurrently.

Optimal wellbeing

In total, 24% (n=3,964) of the sample met the criteria for optimal wellbeing (Table 7). Over half the sample (54%) met the criteria for positive functioning, whilst 41% and 44% met the criteria for positive emotions and positive characteristics, respectively (Table 7).

Table 7. Proportion of the sample meeting the criteria for optimal wellbeing (n=9,514)

Wellbeing features	n	%
Optimal wellbeing	2303	24
Positive emotion	3917	41
Positive characteristics (total meeting 4 of 5 features)	4219	44
Vitality	3712	39
Optimism	5918	62
Resilience	4357	46
Self-esteem	6431	68
Emotional stability	8414	88
Positive functioning (total meeting 3 of 4 features)	5103	54
Meaning	6801	72
Positive relationships	6488	68
Engagement	4210	44
Competence	5499	58

Optimal wellbeing was calculated as meeting thresholds for a) positive emotion and; b) four out of five features of positive characteristics – vitality, optimism, resilience, self-esteem, emotional stability and; c) three out of four features of positive functioning – meaning, positive relationships, engagement, competence^{18; 62}.

Lifestyle behaviours and optimal wellbeing

Table 6 shows the crude, partially adjusted (age, gender, ethnicity, and household income), and fully adjusted (all demographic and lifestyle variables) odds ratios and bootstrapped 95% CIs for optimal wellbeing and each of the socio-demographic and lifestyle variables assessed.

Socio-demographic variables. No associations between gender and optimal wellbeing were observed.

The trend across the three models indicates the likelihood of achieving the criteria for optimal wellbeing increases with age. The fully adjusted odds ratios show those aged 70-79 years were significantly more likely to report optimal levels of wellbeing compared with those aged less than 20 years (OR: 2.00, 95% CI: 1.16-3.51, $p<0.05$).

No association was observed between ethnicity and achieving the criteria for optimal wellbeing in the crude model. However, when adjusting for age, gender, and household income, Asian people and Maori/Pacific people were significantly more likely to meet the criteria for optimal levels of wellbeing compared with European/Other people. In the fully adjusted model the association between ethnicity and optimal wellbeing remained for Maori/Pacific people (1.52, 1.23-1.89, $p<0.01$) but was negated for Asian people.

Household income was significantly associated with optimal wellbeing in each model. In the fully adjusted model those in the middle and highest income tertiles were 1.30 (1.10-1.56, $p<0.01$) and 1.84 (1.55-2.23, $p<0.01$) times more likely, respectively, to reach the criteria for optimal wellbeing compared with those in the lowest income tertile.

Nutrition variables. The average number of servings of fruit and vegetables consumed each day were positively and significantly associated with optimal wellbeing in the crude and partially adjusted models. However, these associations were negated in the fully adjusted model.

Sugary drink intake was inversely and significantly associated with optimal wellbeing in the crude and partially adjusted models. In the fully adjusted model consuming sugary drinks 5-6 times per week was associated with a decreased likelihood (0.73, 0.53-0.95, $p<0.05$) of achieving the criteria for optimal wellbeing, compared with those who reported that they do not consume sugary drinks.

Compared with those that reported eating breakfast daily, eating breakfast 1-2 days per week (0.75, 0.58-0.93, $p<0.05$) and 5-6 days per week (0.67, 0.52-0.84, $p<0.01$) were associated with a decreased likelihood of being in the optimal wellbeing group.

The crude and partially adjusted models showed obese people were significantly less likely to have optimal levels of wellbeing compared with normal weight people; however, this association was negated in the fully adjusted model. Conversely, overweight people were significantly more likely to have optimal levels of wellbeing compared with normal weight people in all three models.

Health risk behaviours. Compared with smokers, being a non-smoker was associated with an increased likelihood of reaching the criteria for optimal wellbeing in the crude (1.60, 1.40-1.85, $p<0.01$) and partially adjusted (1.44, 1.23-1.72, $p<0.01$) models; however, these associations were negated in the fully adjusted model.

Compared with those that consume alcohol up to four times per month, drinking alcohol monthly or less was significantly associated with a decreased likelihood of being in the optimal wellbeing group in the crude (0.73, 0.64-0.85, $p<0.01$), partially adjusted (0.72, 0.61-0.85, $p<0.01$), and fully adjusted (0.76, 0.62-0.92, $p<0.01$) models.

Exercise and sedentary behaviour. Exercise was positively and significantly associated with achieving the criteria for optimal wellbeing in all three models. Compared with those who reported doing no exercise, exercising seven or more times per week was associated with a 1.61 (1.22-2.13, $p<0.01$) increased likelihood of being in the optimal wellbeing group in the fully adjusted model.

An inverse relationship between sedentary levels and optimal wellbeing was observed in all three models; decreases in sedentary behaviour were associated with an increased likelihood of meeting the criteria for optimal wellbeing. In the fully adjusted model, those who reported sitting none or almost none of the time during the past week were 1.87 (1.01-3.29, $p<0.01$) times more likely to meet the criteria for optimal wellbeing.

Sleep. In all three models, restless sleep was negatively associated with optimal wellbeing. In the fully adjusted model, having restless sleep all or almost all of the time was associated with a significantly decreased (0.24, 0.17-0.32, $p<0.01$) likelihood of being in the optimal wellbeing group compared with those reporting restless sleep none or almost none of the time.

Discussion

To develop positive health and wellbeing interventions a better understanding of the characteristics and behaviours associated with optimal wellbeing is needed. In the present study, a multi-dimensional measure of optimal wellbeing was used to classify those with the highest levels of wellbeing in a large and diverse sample of New Zealand adults. Our findings show 24% of the sample met the criteria for optimal wellbeing. The second aim of the study was to integrate measures from public health and positive psychology to determine lifestyle behaviours associated with a multi-dimensional measure of optimal wellbeing. In the fully adjusted model, optimal wellbeing was positively associated with exercise, inversely associated with sedentary behaviour, and negatively associated with sleep.

In previous research on life satisfaction, New Zealand ranks similar or just below the highest ranked Scandinavian nations.²²⁶ Comparing our findings to the largest study of optimal wellbeing in Europe suggests that proportion of New Zealanders meeting the criteria for optimal wellbeing in the current sample is comparable to Sweden (24%; ranked 7 of 22).¹⁸

Nevertheless, the 24% reported in our sample is substantially lower than the prevalence of optimal wellbeing in the highest ranked country, Denmark (41%).¹⁸ Our data indicates that individuals in our sample who were more likely to achieve the criteria for optimal wellbeing were those with higher household incomes and those aged 70-79 years. It was also interesting to observe, that in contrast to previous research reporting lower levels of satisfaction with life among Maori and Pacific people,^{227; 228} we found no evidence to support this relationship. In contrast, we found those who identified as Maori or Pacific were more likely to achieve optimal levels of wellbeing compared with those who identified as European. Whilst these ethnic differences in optimal wellbeing warrant further investigation, the discrepancy between our research and others may in part be explained by the wellbeing measures used. We used broader criteria to measure optimal wellbeing that takes into account dimensions such as positive relationships and meaning and purpose. Maori and Pacific people may have scored higher on these dimensions due to the cultural value placed on philosophies such as *whanau ora* and *hauora*.²²⁹ For example, *whanau ora* emphasises the family and community whilst *hauora* emphasises physical, mental and emotional, social, and spiritual wellbeing approaches to health.²²⁹

In the present study, we extend previous research on life satisfaction⁵⁰ and happiness⁵¹ to show for the first time that sleep, exercise, and sedentary behaviour are independently associated with a multi-dimensional measure of optimal wellbeing. Although exercise, and to a lesser extent minimising sedentary behaviour, are important public health priorities, sleep is often overlooked. There is now increasing evidence to show that sleep is associated with health outcomes.²³⁰ Our findings also indicate that reporting restless sleep ‘almost all of the time’ was associated with 0.24-fold decreased likelihood of meeting the criteria for optimal wellbeing, compared with those reporting restless sleep ‘almost none of the time’. This is concerning as there is accumulating evidence to suggest that there has been a global reduction in sleep.^{29; 30} Given the potential implications for health and wellbeing, increased efforts should be made to raise awareness of strategies to improve sleep quality.

To a lesser degree, associations between optimal wellbeing and breakfast consumption, sugary drink intake, BMI, and alcohol consumption were also observed in the current study. Similar associations between breakfast consumption and happiness have been observed previously.⁵¹

In our study, we found that compared with those who drink alcohol up to four times per month, drinking alcohol monthly or less was associated with a 0.76-fold decreased likelihood of achieving the criteria for optimal wellbeing. Though not significant Piqueras et al.⁵¹ reported a similar trend; compared with those that never drink those who reported drinking were more likely to be classified as happy (OR 1.07; $p=0.52$). One possible explanation for this somewhat unexpected finding is that those occasionally drinking may be doing so in social environments thereby benefiting from social interaction and enhanced positive relationships. Finally, consuming sugary drinks 5-6 times per week was associated with a 0.73-fold decreased likelihood of achieving the criteria for optimal wellbeing. Limiting sugar is, therefore, likely to have implications from both a health and wellbeing perspective.

The relationship between lifestyle behaviours and optimal wellbeing is complex and likely to be bidirectional. On the one hand, if individuals feel optimistic, energetic, confident, and supported they are probably more likely to engage in positive lifestyle behaviours.²³¹ Alternatively, there is also evidence to support the claim that optimal wellbeing is enhanced by healthy lifestyle behaviours.⁶³ Specifically, experimental research in human and animal studies shows that engaging in healthy behaviours such as exercise,¹¹³ healthy eating,^{232; 233} and quality sleep²³⁴ reduces inflammation and enhances BDNF. Reducing inflammation and enhancing BDNF expression promotes neuroplasticity which is important for dimensions of optimal wellbeing related to creativity, exploration, and curiosity.⁶³

It is pertinent to note that three quarters of the sample in the current study were not meeting the criteria for optimal wellbeing. It is therefore evident that further efforts need to be made promote and increase optimal wellbeing. Whilst the causal relationship between lifestyle behaviours and optimal wellbeing cannot be determined from our data, existing evidence supports the claim that the relationship is likely to be bidirectional. Our findings, together with the literature, provide support for holistic interventions that integrate the promotion of lifestyle behaviours and the dimensions underpinning optimal wellbeing (e.g., relationships, self-esteem, and resilience). Our research shows the lifestyle variables that should be targeted in such interventions include sleep, exercise, and sedentary behaviour, and to a lesser degree sugary drink consumption and breakfast intake.

Limitations

The findings from this study should be considered in light of the limitations. Firstly, although the web-based survey design offered a number of advantages, the response rate was low (32%). Comparisons to the estimated resident population during the September 2012 quarter indicate our sample was slightly over-represented by younger adults and slightly under-represented by those aged over 60 years. Secondly, the current study relied on self-reported lifestyle behaviours, rather than observational measures. There is therefore a possibility that individuals were subject to social desirability bias. Finally, the cross-sectional nature of the data precludes the ability to infer causation. The relationship between lifestyle behaviours and optimal wellbeing is complex and likely to be bidirectional. Intervention and mechanistic studies are required to further progress our understanding of this relationship. The findings from this study provide a starting point for determining the most pertinent lifestyle variables to include in such research.

Conclusion

In this study, two research fields—positive psychology and public health—have been integrated to examine the relationship between lifestyle behaviours and optimal wellbeing. The current study contributes to the limited wellbeing research in New Zealand to show almost a quarter of a large and demographically diverse sample of New Zealanders are meeting the criteria for optimal wellbeing. This study also extends current international knowledge to show sleep, exercise, and sedentary behaviour, and to a lesser degree breakfast consumption, sugary drink intake, BMI, and alcohol consumption are associated with a broader, more complex notion of wellbeing. It is likely this relationship between lifestyle behaviours and optimal wellbeing is bidirectional giving rise to the debate that holistic approaches are needed to promote positive health.

The clustering of lifestyle behaviours in New Zealand and their relationship with optimal wellbeing

Preface

In the previous chapter, it was observed that just 24% of a large and diverse sample of New Zealanders are meeting the criteria for optimal wellbeing. This concerning finding strengthens the argument for developing initiatives to explicitly promote positive health. Having established that lifestyle behaviours are associated with optimal wellbeing, the next step is to identify how lifestyle behaviours might be promoted within a positive health framework. Some public health researchers argue that the limited practice of promoting multiple lifestyle behaviours, concurrently, should be increased. Exploring the clustering of lifestyle behaviours is useful for identifying whether isolated or multiple behaviours should be targeted in an intervention.

The work in this chapter (Chapter 4) extends the findings from the previous chapter by investigating, for the first time, the association between engaging in multiple healthy lifestyle behaviours and optimal wellbeing. In addition, the clustering of healthy and unhealthy lifestyle behaviours are explored using data from a large and diverse sample of New Zealanders. The findings from this chapter provide the first evidence to show healthy (and unhealthy) levels of physical activity, sedentary behaviour, sleep, sugary drink consumption, and fruit and vegetable intake cluster together. These findings support targeting multiple lifestyle behaviours in positive health initiatives.

The manuscript resulting from this chapter have been published in the peer-reviewed journal, International Journal of Behavioral Medicine. Data for this study were analysed by the candidate (KP).

Abstract

Purpose. The purpose of this research was to determine (1) associations between multiple lifestyle behaviours and optimal wellbeing and (2) the extent to which five lifestyle behaviours—sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—cluster in a national sample.

Methods. A national sample of New Zealand adults participated in a web-based wellbeing survey. Five lifestyle behaviours—sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—were dichotomised into healthy (meets recommendations) and unhealthy (does not meet recommendations) categories. Optimal wellbeing was calculated using a multi-dimensional flourishing scale and binary logistic regression analysis was used to calculate the relationship between multiple healthy behaviours and optimal wellbeing. Clustering was examined by comparing the observed and expected prevalence rates (O/E) of healthy and unhealthy two-, three-, four-, and five-behaviour combinations.

Results. Data from 9,425 participants show those engaging in 4-5 healthy behaviours (23%) were 4.7 (95% confidence interval (CI) 3.8-5.7) times more likely to achieve optimal wellbeing compared with those engaging in 0-1 healthy behaviour (21%). Clustering was observed for healthy (5%, O/E 2.0, 95% CI 1.8-2.2) and unhealthy (5%, O/E 2.1, 95% CI 1.9-2.3) five-behaviour combinations and for four- and three- behaviour combinations. At the two-behaviour level, healthy fruit and vegetable intake clustered with all behaviours, except sleep that did not cluster with any behaviour.

Conclusions. Multiple lifestyle behaviours were positively associated with optimal wellbeing. The results show lifestyle behaviours cluster providing support for multiple behaviour lifestyle-based interventions for optimising wellbeing.

Introduction

Positive health is an emerging paradigm where health is considered beyond the absence of disease.^{14; 52; 59} Within this paradigm optimal wellbeing, or flourishing as it is also referred, epitomises positive health. Optimal wellbeing has been operationalised as a multi-dimensional construct incorporating measures of feeling good (e.g., positive emotion, vitality, and resilience) and functioning well (e.g., engagement, competence, and meaning).¹⁸ Recent epidemiological evidence shows the prevalence of optimal wellbeing in New Zealand is low, with 75% of the population failing to achieve optimal wellbeing.²³⁵ Similar low levels of optimal wellbeing have been reported in many European countries.¹⁸ It is evident from these findings that identifying and promoting behaviours associated with increased wellbeing is warranted.

Walsh²³⁶ argues health professionals have significantly underestimated the importance of lifestyle behaviours for mental health. There is now plausible evidence to indicate individual healthy lifestyle behaviours are associated with optimal wellbeing.^{165; 235} Furthermore, findings from a recent study show those who engage in fewer health risk behaviours were more likely to be satisfied with their lives.⁵² However, it is currently unknown whether a similar positive association occurs between engaging in multiple healthy lifestyle behaviours and optimal wellbeing. As well as understanding the relationship between multiple behaviours and optimal wellbeing, examining the distribution of these behaviours within the population would be useful for intervention planning.²³⁷ If lifestyle behaviours cluster, interventions targeting multiple lifestyle behaviours may be more efficient and cost effective than promoting lifestyle behaviours in isolation.³³

Clustering can be used to examine whether lifestyle behaviours co-occur or occur independently in a population.²³⁸ In previous studies, between three and five lifestyle behaviours have been dichotomised into healthy (e.g., meets physical activity recommendations) and unhealthy (e.g., does not meet physical activity recommendations) behaviours and the clustering of healthy and unhealthy behaviour combinations have been explored.^{238; 239; 240; 241} Whilst there is now increasing international research in this area, evidence on the clustering of lifestyle behaviours in New Zealand is limited and the findings mixed.^{240; 241} Tobias et al.,²⁴⁰ for example, examined the clustering of four lifestyle behaviours—physical activity, fruit and vegetable intake, alcohol,

and smoking—in a sample of 10,241 New Zealand adults with no history of cardiovascular disease or cancer. The authors found unhealthy lifestyle behaviours clustered together; however, healthy lifestyle behaviours clustered to a lesser degree. In a more recent study, Williden et al.²⁴¹ examined the clustering of body mass index and two lifestyle behaviours—physical activity and fruit and vegetable consumption—in a sample of 1,296 white-collared employees. In contrast to Tobias et al.’s²⁴⁰ results, no evidence was found to support the clustering of healthy or unhealthy lifestyle behaviours.²⁴¹ These contrasting findings indicate further research is needed to develop a more comprehensive understanding of the distribution of lifestyle behaviours in New Zealand.

The selection of lifestyle behaviours has varied in both the international^{204; 205; 237; 242; 243} and national^{240; 241} clustering literature. Nonetheless, most of the lifestyle behaviours investigated in these studies were chosen due to their explicit associations with chronic disease (e.g., lack of physical activity, inadequate fruit and vegetable intake, alcohol consumption, and smoking).^{204; 205; 237; 240; 241; 242; 243} Few studies have, however, explored the clustering of other lifestyle behaviours—including sedentary behaviour, sleep, or sugar consumption—which are not only associated with health^{116; 230; 244} but also wellbeing.^{235; 245} There is now substantial evidence to show sedentary behaviour, for example, is adversely associated with health¹¹⁶ and wellbeing;^{235; 245} independently of physical activity. Similarly, inverse associations between sugar consumption and health²⁴⁴ and wellbeing²³⁵ have been documented in the literature. Understanding how lifestyle behaviours associated with health and wellbeing are dispersed across the population would be useful for informing positive health interventions. The aims of this study are two-fold: (1) To advance the literature by determining the association between multiple lifestyle behaviours and optimal wellbeing; and (2) To extend beyond conventional behaviours to determine the extent to which behaviours—including sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—cluster in a national sample of New Zealand adults. Findings from this research will be used to inform lifestyle-based interventions targeting behaviours for optimal wellbeing.

Methods

Study design

Data were drawn from the Sovereign Wellbeing Index (Round 1), a cross-sectional study of wellbeing in New Zealand which has been described in detail elsewhere.^{209; 235} Ethical approval to conduct the study was granted by the Auckland University of Technology Ethics Committee (AUTEC 12/201).

Participants

Participants were recruited from the largest commercial database in New Zealand. A total of 38,439 New Zealand adults (aged over 18 years) were invited via email to participate in a web-based wellbeing survey. The web-based survey utilised a point-and-click interface and included 134 questions on wellbeing, health and lifestyle, and socio-demographics. Data were collected between September 2012 and October 2012. All participants provided informed consent prior to entering the survey.

Measures

Measures specific to the current study only are described in detail below.

Lifestyle behaviours

Five lifestyle behaviours were selected for inclusion in this study; sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake. Each lifestyle behaviour was dichotomised into healthy and unhealthy categories.

Sleep was measured using a single-item (*How much of the time during the past week did you experience restless sleep?*) drawn from the European Social Survey (Round 6).²²¹ Similar to previous research, responses were dichotomised into healthy (experiencing restless sleep none/almost none of the time or some of the time) and unhealthy (experiencing restless sleep most or all/almost all of the time) categories.^{222; 223}

Physical activity and sedentary behaviour were measured using the Lifestyle Physical Activity and Sedentary Scale, an original scale developed for the Sovereign Wellbeing Index.²⁴⁶

Physical activity was assessed using six items which took into account; lifestyle physical activity, active transport, and purposeful exercise. Responses were used to profile individuals' physical activity as very low, low, moderate, or high. Very low and low physical activity profiles were classified as unhealthy (i.e., falling substantially below or doing some activity but unlikely to be meeting the Ministry of Health's guidelines for physical activity); while moderate and high physical activity profiles were classified as healthy (i.e., meeting or exceeding the Ministry of Health's guidelines for physical activity).²⁴⁷

Sedentary scores were calculated using a single-item sitting question (*How much of the time during the past week did you spend sitting?*) from the Lifestyle Physical Activity and Sedentary Scale.^{235; 246} Based on their responses, participants were classified as having very low (none/almost none of the time), low (a little of the time), moderate (some of the time), or high (most or all/almost all of the time) sedentary levels. There are currently no standardised thresholds for classifying unhealthy and healthy levels of sedentary behaviour. The following dichotomies were therefore utilised for this study: low and very low sedentary levels were classified as healthy; moderate and high sedentary levels were classified as unhealthy.

Sugary drink consumption was used as a proxy for sugar intake and was assessed using a single-item question (*How often during the past week did you drink sugary beverages?*).²¹⁵ Respondents were instructed to include all energy drinks, carbonated drinks (i.e., fizzy drinks), fruit juice, and cordial (diet drinks were excluded). Current Ministry of Health guidelines were used to classify sugary drink consumption as healthy (< 1 time/week) and unhealthy (≥ 1 time/week).²⁴⁷

Fruit and vegetable intake were measured using two questions drawn from the New Zealand Health Survey.²¹⁵ The questions asked participants to report on average how many servings of fruit and vegetables they had each day over the past week. Current Ministry of Health guidelines were used to classify fruit and vegetable intake as healthy (≥ 2 servings of fruit and ≥ 3 servings of vegetables) or unhealthy (< 2 servings of fruit or < 3 servings of vegetables).²

Optimal wellbeing

Optimal wellbeing was treated as a binary variable and was calculated using a modified version of Huppert and So's flourishing scale.^{18; 62} Ten items, originally drawn from the European Social Survey (Round 6),²¹⁴ were used to calculate optimal wellbeing. The ten items included measures of happiness, vitality, optimism, resilience, self-esteem, emotional stability engagement, meaning, optimism, and positive relationships.¹⁸ These items combine both hedonic (feelings) and eudaimonic (functioning) aspects of wellbeing and were designed to mirror the internationally agreed criteria for depression and anxiety.¹⁸ Items were rated on 4-point to 11-point Likert scales.⁶² All items were phrased in a positive direction except for the item measuring resilience, which was reverse coded. Hone et al.'s⁶² thresholds were used to calculate whether participants met the criteria for each item. Optimal wellbeing was determined as meeting the thresholds for positive emotion (happiness); and four out of five features of positive characteristics (vitality, optimism, resilience, self-esteem, emotional stability); and three out of four features of positive functioning (engagement, meaning, competence, positive relationships).⁶²

Data analysis

Multiple lifestyle behaviours and optimal wellbeing. Firstly, the prevalence of healthy and unhealthy dichotomies were calculated for each lifestyle behaviour. To determine whether engaging in multiple healthy lifestyle behaviours was associated with optimal wellbeing, the prevalence rates of the sample engaging in 0-5 healthy lifestyle behaviours were calculated. Binary logistic regression analyses (IBM SPSS Statistics version 19 for Windows) were used to calculate crude and adjusted (age, gender, ethnicity, and household income) odds ratios and 95% confidence intervals (CI) for being in the optimal wellbeing group. The alpha was set at $p < 0.05$ to determine statistical significance.

Clustering. Clustering ratios (observed prevalence/expected prevalence), 95% CIs, and the prevalence of optimal wellbeing were calculated for all possible two-, three-, four-, and five-healthy and unhealthy behaviour combinations. The observed prevalence was calculated as the proportion of the sample in each behaviour combination examined in this study. The expected

prevalence was calculated by multiplying the observed prevalence of the individual behaviours together (e.g., healthy sleep*healthy physical activity).²⁴¹ These clustering ratios were used to determine whether lifestyle behaviours clustered or occurred independently in the sample. Ratios >1 indicated clustering (i.e., the observed prevalence is higher than the expected prevalence); ratios <1 indicated that the behaviours occurred independently.^{240; 248}

Results

Participant characteristics

In total, 9,962 New Zealand adults completed the survey. Participants were excluded from analysis if they were missing data from any of the five lifestyle behaviours (5%; $n=537$). Thus, valid data were available from 9,425 (47% male) participants. Table 8 provides a summary of the participant characteristics.

Table 8. Participant characteristics (n=9,425)

	Number (n)	Percent (%)		Number (n)	Percent (%)
Gender			Household income tertile		
Male	4415	47	≤ \$40,000	2351	25
Female	4993	53	\$40,001 - \$90,000	2523	27
Missing	17	0.2	≥ \$90,001	2204	23
			Missing	2347	25
Age			Ethnicity		
< 40 years	3513	37	European/other	7045	75
40 - 59 years	2740	29	Asian	987	11
≥ 60 years	1895	20	Maori/Pacific	1222	13
Missing	1277	14	Missing	171	2

Prevalence of individual behaviours

Of the total sample, 69% experienced healthy sleep, 58% had healthy levels of physical activity, 60% had healthy sedentary levels, 43% had a healthy consumption of sugary drinks, and 25% had a healthy fruit and vegetable intake.

Multiple lifestyle behaviours and optimal wellbeing

Overall, 5% of the sample reported not engaging in any healthy lifestyle behaviours and 5% reported engaging in all five healthy lifestyle behaviours over the past week (Figure 8).

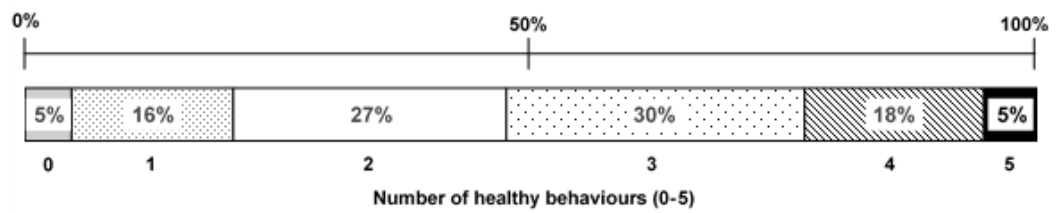


Figure 8. The proportion of the sample engaging in nil to five healthy lifestyle behaviours.

Participants were asked to report on their engagement in five lifestyle behaviours (sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake) over the past week.

Optimal wellbeing data were available for 9,235 participants. In total, 24% of the sample met the criteria for optimal wellbeing. Table 9 shows the prevalence of optimal wellbeing and the likelihood of being in the optimal wellbeing group based on the number of healthy lifestyle behaviours endorsed. The adjusted odds ratios show that those engaging in four or five healthy lifestyle behaviours were 4.7 (95% CI 3.8-5.7) times more likely to fall into the optimal wellbeing group compared with those engaging in 0-1 healthy lifestyle behaviours.

Table 9. Prevalence and likelihood of being in the optimal wellbeing group based on the number of healthy lifestyle behaviours endorsed ($n=9,235$)

	Non-optimal wellbeing <i>n</i> (%)	Optimal wellbeing <i>n</i> (%)	Crude odds ratio (95% CI ¹)	Adjusted ² odds ratio (95% CI)
Total	6979 (76)	2256 (24)		
0-1 healthy behaviour(s)	1697 (89)	213 (11)	Reference	Reference
2-3 healthy behaviours	4024 (77)	1177 (23)	2.3 (2.0-2.7)	2.2 (1.8-2.7)
4-5 healthy behaviours	1258 (59)	866 (41)	5.5 (4.6-6.5)	4.7 (3.8-5.7)

¹Confidence interval

²Adjusted for age, gender, ethnicity, and household income

Clustering

Tables 10 and 11 show the clustering ratios, 95% CIs, and the prevalence of optimal wellbeing for two-, three-, four-, and five-lifestyle behaviour combination patterns.

Table 10. Prevalence of combinations of healthy lifestyle behaviours

	Observed		Expected	Cluster ratio	Optimal wellbeing
	<i>n</i>	%	%	O/E ¹ (95% CI)	% (95% CI)
Individual behaviours					
Sleep	6526	69			31 (29-32)
Physical activity (PA)	5436	58			29 (27-30)
Sedentary behaviour (SB)	5635	60			29 (27-30)
Sugary drinks	4080	43			29 (28-30)
Fruit and vegetables (FV)	2389	25			33 (31-35)
Two-behaviour combinations					
Sleep*PA	3868	41	40	1.0 (1.0-1.1)	35 (34-37)
Sleep*SB	4026	43	41	1.0 (1.0-1.1)	35 (34-37)
Sleep*Sugary drinks	2923	31	30	1.0 (1.0-1.1)	36 (34-37)
Sleep*FV	1791	19	18	1.1 (1.0-1.1)	39 (37-41)
PA*SB	3849	41	34	1.2 (1.1-1.2)	31 (30-33)
PA*Sugary drinks	2390	25	25	1.0 (1.0-1.1)	33 (32-35)
PA*FV	1572	17	15	1.1 (1.1-1.2)	36 (34-39)
SB*Sugary drinks	2578	27	26	1.1 (1.0-1.1)	33 (31-35)
SB*FV	1602	17	15	1.1 (1.1-1.2)	37 (34-39)
Sugary drinks*FV	1220	13	11	1.2 (1.1-1.2)	37 (34-40)
Three-behaviour combinations					
Sleep*PA*SB	2761	29	24	1.2 (1.2-1.3)	38 (36-40)
Sleep*PA*Sugary drinks	1775	19	17	1.1 (1.0-1.1)	40 (38-42)
Sleep*PA*FV	1201	13	10	1.3 (1.2-1.3)	41 (39-44)
Sleep*SB*Sugary drinks	1916	20	18	1.1 (1.1-1.2)	40 (38-42)
Sleep*SB*FV	1245	13	10	1.3 (1.2-1.3)	42 (39-45)
Sleep*Sugary drinks*FV	945	10	8	1.3 (1.2-1.4)	43 (40-46)
PA*SB*Sugary drinks	1738	18	15	1.2 (1.2-1.3)	36 (34-38)
PA*SB*FV	1169	12	9	1.4 (1.3-1.5)	39 (36-41)
PA*Sugary drinks*FV	806	9	6	1.4 (1.3-1.4)	40 (37-44)
SB*Sugary drinks*FV	830	9	7	1.3 (1.3-1.4)	41 (38-45)
Four-behaviour combinations					
Sleep*PA*SB*Sugary drinks	1308	14	10	1.3 (1.3-1.4)	42 (40-45)
Sleep*PA*SB*FV	911	10	5	2.1 (2.0-2.3)	44 (40-47)
Sleep*PA*Sugary drinks*FV	643	7	4	1.6 (1.4-1.7)	45 (41-49)
Sleep*SB*Sugary drinks*FV	669	7	5	1.6 (1.4-1.7)	46 (42-50)
PA*SB*Sugary drinks*FV	608	6	4	1.7 (1.6-1.8)	43 (39-47)
Five-behaviour combination					
Sleep*PA*SB*Sugary drinks*FV	495	5	3	2.0 (1.8-2.2)	47 (43-51)

¹Observed prevalence/expected prevalence

Table 11. Prevalence of combinations of unhealthy lifestyle behaviours

	Observed		Expected	Cluster ratio	Optimal wellbeing
	<i>n</i>	%	%	O/E ¹ (95% CI)	% (95% CI)
Individual behaviours					
Sleep	2899	31			11 (9-12)
Physical activity (PA)	3989	42			19 (17-20)
Sedentary behaviour (SB)	3790	40			18 (17-20)
Sugary drinks	5345	57			21 (20-22)
Fruit and vegetables (FV)	7036	75			21 (21-22)
Two-behaviour combinations					
Sleep*PA	1331	14	13	1.1 (1.0-1.1)	8 (6-9)
Sleep*SB	1290	14	12	1.1 (1.0-1.2)	9 (7-10)
Sleep*Sugary drinks	1742	18	17	1.1 (1.0-1.1)	10 (8-11)
Sleep*FV	2301	24	23	1.1 (1.0-1.1)	9 (8-10)
PA*SB	2203	23	17	1.4 (1.3-1.4)	15 (14-17)
PA*Sugary drinks	2299	24	24	1.0 (1.0-1.1)	16 (14-17)
PA*FV	3172	34	32	1.1 (1.0-1.1)	16 (15-18)
SB*Sugary drinks	2288	24	23	1.1 (1.0-1.1)	16 (15-18)
SB*FV	3003	32	30	1.1 (1.0-1.1)	16 (15-18)
Sugary drinks*FV	4176	44	42	1.0 (1.0-1.1)	19 (18-20)
Three-behaviour combinations					
Sleep*PA*SB	810	9	5	1.6 (1.5-1.8)	7 (5-9)
Sleep*PA*Sugary drinks	789	8	7	1.1 (1.1-1.2)	7 (5-9)
Sleep*PA*FV	1104	12	10	1.2 (1.1-1.3)	7 (6-9)
Sleep*SB*Sugary drinks	795	8	7	1.2 (1.1-1.3)	8 (6-10)
Sleep*SB*FV	1049	11	9	1.2 (1.1-1.3)	8 (6-10)
Sleep*Sugary drinks*FV	1419	15	13	1.2 (1.1-1.2)	8 (7-10)
PA*SB*Sugary drinks	1353	14	10	1.5 (1.4-1.6)	13 (12-15)
PA*SB*FV	1819	19	13	1.5 (1.4-1.6)	14 (12-15)
PA*Sugary drinks*FV	1896	20	18	1.1 (1.1-1.2)	14 (13-16)
SB*Sugary drinks*FV	1891	20	17	1.2 (1.1-1.2)	15 (13-16)
Four-behaviour combinations					
Sleep*PA*SB*Sugary drinks	500	5	3	1.8 (1.6-1.9)	6 (4-8)
Sleep*PA*SB*FV	682	7	5	1.4 (1.3-1.5)	7 (5-9)
Sleep*PA*Sugary drinks*FV	674	7	6	1.3 (1.2-1.4)	7 (5-9)
Sleep*SB*Sugary drinks*FV	668	7	5	1.4 (1.3-1.5)	7 (5-9)
PA*SB*Sugary drinks*FV	1161	12	7	1.7 (1.6-1.8)	13 (11-15)
Five-behaviour combination					
Sleep*PA*SB*Sugary drinks*FV	436	5	2	2.1 (1.9-2.3)	6 (4-8)

¹Observed prevalence/expected prevalence

Five-behaviour combinations. Clustering—indicated by a ratio >1.0—was observed for both the healthy and unhealthy five-behaviour combinations. The observed prevalence of having all five healthy (cluster ratio 2.0, 95% CI 1.8-2.2) or unhealthy (cluster ratio 2.1, 95% CI 1.9-2.3) behaviours was higher than could have been expected on the basis of the individual

probabilities of the five behaviours alone. In total, 47% (95% CI 43-51) of people who met the guidelines for all five healthy behaviours were classified as having optimal levels of wellbeing. Conversely, 6% (95% CI 4-8) of the unhealthy group were classified as having optimal levels of wellbeing.

Four-behaviour combinations. Clustering was observed in all four-behaviour combinations. The greatest degree of clustering was observed between the healthy combination of sleep, physical activity, sedentary behaviour, and fruit and vegetable intake (2.1, 95% CI 2.0-2.3). In total, 10% of the sample met these four healthy behaviours and the prevalence of optimal wellbeing within this group was 44% (95% CI 40-47). Of the unhealthy behaviour combinations, the greatest degree of clustering was observed between sleep, physical activity, sedentary behaviour, and sugary drinks (1.8, 95% CI 1.6-1.9). For this group, the prevalence of optimal wellbeing was 6% (95% CI 4-8%).

Three-behaviour combinations. A degree of clustering was observed between all three-behaviour combinations; except the healthy combination of sleep, physical activity, and sugary drinks (1.1, 95% CI 1.0-1.1). Of the healthy behaviour combinations, the greatest degree of clustering was observed between physical activity, sedentary behaviour, and fruit and vegetable intake (1.4, 95% CI 1.3-1.5) and between physical activity, sugary drinks, and fruit and vegetable intake (1.4, 95% CI 1.3-1.4). For the unhealthy behaviours physical activity, sedentary behaviour, and sugary drink consumption (1.5, 95% CI 1.4-1.6); and physical activity, sedentary behaviour, and fruit and vegetable intake (1.5, 95% CI 1.4-1.6) showed the greatest degree of clustering.

Two-behaviour combinations. Most of the healthy and unhealthy two-behaviour patterns showed a degree of clustering. For the healthy lifestyle behaviours the greatest degree of clustering was observed between physical activity and sedentary behaviour (1.2, 95% CI 1.1-1.2); and between sugary drink consumption and fruit and vegetable intake (1.2, 95% CI 1.1-1.2). A healthy fruit and vegetable consumption clustered with all behaviours (physical activity, sedentary behaviour, and sugary drinks), except sleep. For the unhealthy lifestyle behaviours only physical activity and sedentary behaviour clustered (1.4, 95% CI 1.3-1.4). At the two-behaviour level, sleep did not cluster with any other behaviour.

In summary, the greatest degree of clustering was observed between the healthy combination of sleep, physical activity, sedentary behaviour, and fruit and vegetable intake and the unhealthy combination of sleep, physical activity, sedentary behaviour, sugar drinks, and fruit and vegetable intake. The prevalence of optimal wellbeing was higher in the healthy behaviour combinations compared with the unhealthy behaviour combinations.

Discussion

The first aim of this study was to determine the association between multiple lifestyle behaviours and optimal wellbeing in a national sample of New Zealand adults. The results showed a positive association between the number of healthy lifestyle behaviours endorsed and the likelihood of achieving the criteria for optimal wellbeing. Those engaging in four or five healthy lifestyle behaviours were 4.7 (95% CI 3.8-5.7) times more likely to achieve the criteria for optimal wellbeing compared with those engaging in none or one healthy lifestyle behaviour. The second aim of this study was to investigate the extent to which five lifestyle behaviours—sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—clustered. In this study, clustering was observed for healthy and unhealthy five-, four- and three-behaviour combinations, though the extent to which the behaviours clustered varied. Evidence of clustering was less consistent for the two-behaviour combinations.

The findings from this study indicate engaging in multiple lifestyle behaviours may have a synergistic effect on optimal wellbeing. We show the likelihood of achieving optimal wellbeing increases with the number of healthy lifestyle behaviours endorsed. Nearly 50% of the group engaging in all five healthy behaviours met the criteria for optimal wellbeing, compared with just 6% of those engaging in no healthy lifestyle behaviours. Our results are consistent with previous research that shows engaging in fewer *health risk* behaviours is associated with increased satisfaction with life.⁵² It was, therefore, concerning to find only 5% of the sample engaged in all five healthy lifestyle behaviours. Similar low prevalence rates (3-8%) for meeting multiple healthy lifestyle behaviours have been reported elsewhere.^{205; 241; 243}

Although causation cannot be inferred from our data, findings from intervention studies provide evidence to suggest improvements in isolated behaviours result in improved wellbeing

outcomes.²⁴⁹ Findings from a recent study, for example, show participation in a 4-week fitness programme had a significant and positive effect on satisfaction with life.²⁴⁹ There is also emerging research to suggest the positive affect of multiple healthy lifestyle behaviours on optimal wellbeing is biologically plausible.⁶³ Engaging in healthy lifestyle behaviours enhances neuroplasticity by reducing inflammation and increasing the expression of brain-derived neurotrophic growth factor.^{80; 250} Research shows neuroplasticity is essential for many of the dimensions underpinning optimal wellbeing such as creativity, exploration, and curiosity.^{63; 165} Engaging in a combination of healthy behaviours which cause an overall reduction in inflammation and enhancement in brain-derived neurotrophic growth factor is, therefore, likely to have positive implications for wellbeing.

International research provides compelling evidence to support the clustering of lifestyle behaviours.²⁰⁴ Previous studies show lifestyle behaviours cluster at both ends of the unhealthy-healthy spectrum, with more people than expected engaging in all unhealthy behaviours or all healthy behaviours.^{204; 205; 206} Despite the inclusion of different lifestyle behaviours—including sugary drink consumption, sedentary behaviour, and sleep—the results of the current study are consistent with this international research showing clustering at both ends of the spectrum. Nonetheless, the results from the current study contrast previous national research that has provided little evidence to support the clustering of lifestyle behaviours in New Zealand.^{240; 241} These differences may be attributed to the number and type of lifestyle behaviours included, the use of a homogenous sample,²⁴¹ or the exclusion of people diagnosed with cardiovascular disease or cancer.²⁴⁰

To our knowledge, the current study is the first to examine the extent to which sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake cluster. It was interesting to note that the healthy combination of sleep, physical activity, and sugary drink consumption was the only three-behaviour combination which did not cluster (1.1, 95% CI 1.0-1.1). Furthermore, at the two-behaviour level, sleep did not cluster with any other behaviour, though it clustered at the three-, four- and five-behaviour level. In contrast, physical activity and sedentary behaviour clustered to the greatest degree, particularly for the unhealthy combination (1.4, 95% CI 1.3-1.4). Although these two behaviours are each independently associated with health¹¹⁶ and wellbeing^{235; 245} the current study indicates they occur among the same people in

the population suggesting both behaviours should be targeted in interventions. It was also interesting to find that, for healthy behaviours, the greatest degree of clustering was not observed between all five behaviours. Rather, the four-behaviour combination of sleep, physical activity, sedentary behaviour, and fruit and vegetable intake showed a greater degree of clustering. Based on these results, multi-dimensional lifestyle interventions should target all five behaviours; though increased emphasis should be placed on increasing physical activity, minimising sedentary behaviour, improving sleep, and consuming fruit and vegetables.

Due to the cross-sectional design of clustering studies, it is difficult to determine why lifestyle behaviours cluster together, especially at the unhealthy and healthy ends of the spectrum. Clustering may partly be explained by social and environmental factors.²⁵¹ There is, however, some evidence to suggest the clustering of lifestyle behaviours may be influenced by a behaviour-biochemistry feedback loop.²⁵² For example, several researchers have demonstrated a negative behaviour-biochemistry feedback loop in their research.^{252; 253; 254; 255} They show chronically raised insulin resulting from poor lifestyle choices—such as a poor quality diet, sedentary behaviour, and poor sleep—blocks leptin signalling to the hypothalamus. As leptin is an energy-regulating hormone, the body's ability to regulate energy is impaired. This results in the body initiating an adaptive response to “starvation”; individuals will feel like eating more and moving less, despite having consumed calories in excess.²⁵⁴ It is plausible a similar positive feedback loop may exist.

The evidence to support clustering in the present study raises the possibility of employing multiple behaviour change interventions to enhance wellbeing. There is currently a small, but growing, body of work in which the utility of multiple behaviour change interventions have been explored.³² Several benefits of multiple behaviour change interventions have been identified at both the individual- and population- levels.³³ For individuals, successfully improving one or more lifestyle behaviours may lead to the confidence and self-efficacy to improve others.³³ At the population level, there is evidence to suggest that targeting multiple behaviours concurrently is likely to be both efficient and cost-effective.³³ An intervention targeting the five behaviours we examined, for instance, would have relevance to 95% of our sample as only 5% of our sample engaged in all five healthy lifestyle behaviours. Conversely, an intervention focusing on just physical activity would only have relevance to the 48% of the sample not engaging in the

behaviour. Given the potential benefits, further research investigating the use of multiple behaviour change interventions for improving wellbeing outcomes is warranted.

Strengths of this study include the use of a large heterogeneous sample that represents New Zealand adults across a range of age, income, and ethnic demographics. Limitations of the study includes the cross-sectional design, which precludes the ability to infer causation. Further, the web-based recruitment strategy may also be considered a source of bias. However, findings from a review paper show the age, gender, income, education, and health status of subjects responding to a web-based survey are comparable to those responding to traditional modes of data collection.²¹⁰ Notwithstanding the study's limitations, this research shows diverse behaviours including sleep, sedentary behaviour, and to a lesser degree sugary drink consumption cluster with physical activity and fruit and vegetable intake. Furthermore, this research advances both the public health and positive psychology literature to show, for the first time, that lifestyle behaviours associated with optimal wellbeing cluster.

Conclusion

This research has shown there is a positive association between the number of healthy lifestyle behaviours endorsed and optimal wellbeing. Furthermore, the findings support the notion that lifestyle behaviours cluster at both ends of the healthy- and unhealthy-spectrum. These results suggest further research investigating the use of multiple behaviour change interventions for improving levels of optimal wellbeing is warranted.

Chapter 5

A formative study of laypersons' perceptions of nutrition, physical activity, and sleep guidelines and messages

Preface

There is now evidence to show lifestyle behaviours are associated with optimal wellbeing (Chapters 3 and 4), justifying their inclusion in positive health initiatives. The ensuing work (Chapters 5-8) focuses on the translation of positive health into practice. Firstly, by employing formative research methods to develop in-depth insights of lifestyle behaviour messaging to laypersons' in a framework for positive health (Chapters 5-6). Second, by exploring the implementation of positive health (Chapters 7-8).

In this first formative chapter, qualitative research is used to explore what laypersons like and understand from current nutrition, physical activity, and sleep guidelines. Guidelines in New Zealand inform public health messages that promote nutrition and physical activity behaviours. However, it is unclear which components of the current nutrition and physical activity guidelines are acceptable or resonate with laypersons. Understanding what laypersons like or dislike about guidelines would be useful for informing the development of lifestyle messages that engage the public. To address the absence of official sleep guidelines, specific sleep guidelines were developed for the purposes of this research. This chapter provides the first qualitative research investigation of laypersons' perceptions of nutrition, physical activity, and sleep guidelines in New Zealand.

Data for this chapter were collected between November 2014 and January 2015, prior to the release of the Eating and Activity Guidelines in October 2015. Consequently, the 2003 Food and Nutrition Guidelines for Healthy Adults and 2001 Physical Activity Guidelines for Adults are used in this chapter.

Abstract

Background. Promoting lifestyle behaviour messages in a way that engages the public is challenging. To communicate lifestyle behaviour messages more effectively, it would be useful to know what laypersons like and understand from guideline statements.

Aim. The purpose of this formative research is to evaluate laypersons' perceptions and understanding of nutrition, physical activity, and sleep guidelines. In addition, suggestions of how to promote these guidelines are explored.

Methods. For this qualitative descriptive study, convenience-sampling methods were used to recruit participants for semi-structured focus groups. Participants were shown nutrition, physical activity, and sleep guidelines. Discussions centred on what participants liked and disliked about the guidelines presented. Audio-recordings of the focus groups were transcribed verbatim. Inductive content analysis was used to identify emerging themes and sub-themes.

Results. Five focus groups comprising 16 (25% male) participants were conducted. Three key themes and 13 sub-themes emerged from the data relating to (1) wording and comprehension, (2) application, and (3) promotion of guidelines. Guideline statements were limited by abstract wording and contradictions. Prescriptive physical activity and sleep guidelines were disliked. Participants preferred statements to emphasise social interaction, mitigate barriers, and meet the needs of a broad audience. When promoting lifestyle messages the concomitant relationship between lifestyle behaviours, accessibility of information, benefits beyond weight loss, and using real people should be considered.

Conclusion. The study offers insights into laypersons' perceptions and understanding of public health guidelines. The findings have application for the development and communication of lifestyle behaviour messages.

Introduction

Engaging in healthy lifestyle behaviours is essential for positive health. There is now substantial evidence to support the benefits of healthy eating,²⁷ regular physical activity,²⁸ and quality sleep^{29; 30} for maintaining physical health. Emerging evidence also shows these healthy lifestyle behaviours are associated with optimal wellbeing.²³⁵ However, the prevalence rates of those meeting recommendations for multiple healthy lifestyle behaviours, both in New Zealand and internationally, are low (3-8%).^{205; 243; 256; 257} These concerning findings question the appeal of current strategies used to promote healthy lifestyle behaviours. To effectively promote behaviour change, it is essential the public engages with lifestyle behaviour advice.²⁵⁸

In an effort to encourage the public to adopt healthy lifestyle behaviours, national nutrition and physical activity guidelines have been in place for many years, including in New Zealand,^{180; 181} Australia,^{259; 260} and Canada.^{261; 262} Although in many countries nutrition and physical activity guidelines are disseminated directly to the public, in New Zealand guidelines are primarily developed for health professionals in the health sector.¹⁸² This raises concerns as the health sector predominantly targets individuals most at risk for poor health, thereby limiting the reach of guideline messages. It is also important to encourage individuals who are not currently at health risk to engage in healthy lifestyle behaviours to prevent future health risk and develop a flourishing society. A recent evaluation of New Zealand's nutrition guidelines, highlights that guidelines should reach as many audiences as possible.¹⁸² Considering laypersons' perceptions and understanding of guidelines would therefore be useful for discerning how to effectively communicate guidelines directly to the public.

Positive lifestyle behaviour messaging in public health typically focus on nutrition or physical activity behaviours. However, there is increasing evidence to show sufficient sleep is important for optimal health^{230; 263} and optimal wellbeing.²³⁵ Emerging research shows insufficient sleep clusters together with other unhealthy lifestyle behaviours (including poor nutrition and inactivity), and vice versa.²⁵⁶ Previous research also highlights a concomitant relationship between sleep and other lifestyle behaviours.³⁰ Findings from a recent study in New Zealand, indicate a third of the population currently experience restless sleep.²³⁵ However, efforts to promote sufficient sleep in public health are limited. Before developing messages to promote

sleep to the public, it would be beneficial to understand whether raising awareness of strategies to improve sleep resonates with the public.

To our knowledge, there are no published studies exploring laypersons' perceptions of nutrition or physical activity guidelines in New Zealand. Furthermore, little is known about what laypersons think of promoting sleep. The aims of this formative research were two-fold. First, to explore laypersons' perceptions of nutrition and physical activity guidelines and proposed sleep guidelines. Second, to explore how laypersons would like to see guideline messages promoted. The findings from this study will have application for the dissemination of guidelines and for informing content for positive health messages. The findings will also contribute to the limited knowledge on lay New Zealanders understanding of nutrition and physical activity guidelines.

Methods

This research employed a qualitative descriptive methodology.²⁶⁴ Sandelowski²⁶⁴ describes qualitative descriptive techniques as low-inference descriptions where researchers will more readily agree on the facts. Semi-structured focus groups were used to collect data. Focus groups use interaction to generate data and are useful for understanding people's perceptions and attitudes.²⁶⁵ Auckland University of Technology Ethics Committee provided ethical approval to conduct the study on the 15 September 2014 (AUTEC 14/294).

Participants and setting

Convenience-sampling methods were used to recruit participants into the study. Advertisements were sent via email to the researchers' network and were also placed on two workplace intranet sites. The number of focus groups to be conducted was determined by the point at which data saturation occurred.²⁶⁵ Saturation typically occurs between 1 and 10 focus groups and is considered the point where no new information is emerging.²⁶⁵ All participants provided written informed consent prior to participating in the study.

Procedures

Focus groups were led by female moderators (KP and LM) and carried out in quiet rooms. The focus groups began with an introduction and description of the session format. Participants

received a booklet comprising the nutrition, physical activity, and sleep guidelines to be discussed. The booklets also included examples of campaigns used to disseminate nutrition and physical activity messages in New Zealand. A focus group schedule was used to work through the booklets sequentially to ensure consistency between groups (Table 12). Participants read through and considered a set of guidelines independently, prior to discussion guided by the interview schedule (Table 12). Where appropriate, follow up questions probed for richer information.

Table 12. Focus group interview schedule

Interview schedule
Do the guidelines resonate? What do you like/not like? Have you heard of any of these? Are there features you like/not like? What do you think of having sleep guidelines? How would you like to see these guidelines presented and promoted?

Guidelines

Table 13 shows the content of guidelines discussed with participants. The nutrition guidelines comprised the 2003 Food and Nutrition Guidelines for Healthy Adults.¹⁸⁰ Participants were shown four examples of how the nutrition guidelines have been disseminated in New Zealand including the: Heart Foundation Tick,²⁶⁶ Heart Foundation Heart Healthy Visual Food Guide,¹⁹⁰ 5+ A Day logo,²⁶⁷ and Breakfast-eater's logo (Appendix F).²⁶⁸

The Heart Foundation Tick is currently displayed on products lower in saturated fat, trans fat, sodium, and kilojoules with the aim of guiding consumers' food purchasing choices.¹⁹⁰ The Heart Healthy Visual Food Guide is an update on the food pyramid.¹⁹⁰ The 5+ A Day logo is used to encourage the consumption of five servings of fruit and vegetables per day.²⁶⁷ Finally, the Breakfast-eaters logo reflects a campaign aimed at encouraging children to eat breakfast daily.²⁶⁸

The physical activity guidelines comprised the 2001 Physical Activity Guidelines for Adults.¹⁸¹ The Push Play logo was shown to participants as an example of how the physical activity guidelines have been disseminated in New Zealand.^{269; 270} Push Play represents a national

campaign that ran during the 1990s and early 2000s promoting 30-minutes of activity per day.^{269; 270}

As no sleep guidelines exist in New Zealand, the proposed sleep guidelines were developed for the purposes of this research. The evidence-based sleep guidelines were adapted from Cizza et al.²⁷¹ and focused on strategies such as creating a sleep routine,¹⁹⁴ spending time outdoors,¹⁹⁴ and avoiding alcohol,²⁰² caffeine,²⁰¹ and blue light²⁰⁰ prior to bed.

Table 13. Nutrition, physical activity, and sleep guidelines

Nutrition guidelines ¹⁸⁰	
1.	Maintain a healthy body weight by eating well and by daily physical activity.
2.	Eat well by including a variety of nutritious foods from each of the four major food groups each day. <ul style="list-style-type: none"> • Eat plenty of vegetables and fruits. • Eat plenty of breads and cereals, preferably wholegrain. • Have milk and milk products in your diet, preferably reduced or low-fat options. • Include lean meat, poultry, seafood, eggs or alternatives.
3.	Prepare foods or choose pre-prepared foods, drinks and snacks: <ul style="list-style-type: none"> • with minimal added fat, especially saturated fat • that are low in salt; if using salt, choose iodised salt • with little added sugar; limit your intake of high-sugar foods.
4.	Drink plenty of liquids each day, especially water.
5.	If choosing to drink alcohol, limit your intake.
6.	Purchase, prepare, cook and store food to ensure food safety.
Physical activity guidelines ¹⁸¹	
New Zealand adults should:	
	<ul style="list-style-type: none"> • view movement as an opportunity, not an inconvenience. • be active every day in as many ways as possible. • put together at least 30 minutes of moderate intensity physical activity on most if not all days of the week. • if possible, add some vigorous exercise for extra health benefit and fitness.
Sleep guidelines	
	<ul style="list-style-type: none"> • Create a sleep routine. Wake up and go to bed at the same time each day. • Get outside. Aim to spend time in natural sunlight each day. • Minimise exposure to blue light (including TV, computers, iPads, etc) and caffeine before bedtime.

Data analysis

Audio-recordings of the focus groups were transcribed verbatim (KP). De-identified transcripts were re-read several times in order to become familiar with the data. Transcripts were imported into NVivo (NVivo 10 for Windows; QSR International Pty Limited) for analysis. Using the interview guide as a starting point, inductive content analysis was used to code the data (KP).²⁶⁴ The codes were reviewed and categorised into sub-themes and themes (KP).

Results

Participant characteristics

Focus groups were conducted in Auckland, New Zealand between November 2014 and March 2015. The decision to conduct no further focus groups was made after considering the material from all five groups ($n=3-4$ per group). A total of 21 participants (33% male) expressed interest in taking part in the study. Five participants did not show on the day, leaving 16 participants (mean age 40 years; 25% male). Focus groups lasted for 45- to 60-minutes.

Focus group findings

Three key themes and 13 sub-themes emerged from the data relating to the (1) wording and comprehension, (2) application, and (3) promotion of guidelines (Table 14).

Wording and comprehension

Nutrition guidelines. Wording, including “eat plenty of” and “maintain a healthy body weight by eating well and by daily physical activity”, were described as abstract and unhelpful. Participants preferred positively phrased guideline statements focusing on what to do, rather than what not to do. Preferences for how prescriptive nutrition messages should be were polarising. Some participants liked flexible messages whilst other participants preferred prescriptive messages.

Participants identified contradictions with two guideline statements: the first emphasising foods low in sugar and salt and the second emphasising “plenty of breads and cereals”. These participants observed cereals and breads are often high in sugar. At least one participant in each group reported hearing the food pyramid had “been flipped on its head” or was “outdated”.

Table 14. Summary of emerging themes and sub-themes

Theme	Illustrative quote
Wording and comprehension	
1. Wording (abstract, scientific).	Using the word “plenty”, like eat plenty of breads and cereals, I mean what? (Nutrition guidelines, Female)
2. Contradictory statements versus consistent messages	It says low on salt and low on sugar. But some of these are high in sugar, that you eat plenty of. Like the cereals. (Nutrition guidelines, Female) You see a lot of the frozen foods that are semi-processed, you look at them, and you go the Heart Foundation Tick, it's got a Heart Foundation Tick. It's actually quite junk food!” (Nutrition dissemination; Female)
3. Phrasing (positive verse negative)	There are a lot of don'ts. It's quite negative. It's telling people, limit...If there's a way of rewriting these in a positive nature. (Nutrition guidelines, Male)
Application	
4. Barriers	Physical activity do I do it every day? No. For a number of reasons too busy, just don't feel like it... (Physical activity guidelines, Female)
5. Facilitators	There is nothing about community. The food was all about cooking in a community but if you said.... a team, or take your kids, or make it a family thing. Then you drag your kids along with you but it's also probably more fun. (Physical activity guidelines, Male)
6. Prescriptive versus flexible	The number five, is that random or is that scientifically proven? Because I'm having a baby carrot—is that one [serving]? What is five? (5+ A Day, Male) They [people] think I can't do 30-minutes, so they don't do it. Whereas, if they go for a walk before they know it, an hour has gone by (Physical activity guidelines, Female).
7. Individual variation	I understand these are general and have to be aimed at a broader audience. But eat plenty of cereals and grains, what about all those people that can't? (Nutrition guidelines, Female)
8. Practical messages	I think these things need to be a bit more practical it's like take your dog for a walk, take the stairs and not the lift. Make it more practical for people's lives rather than make people think oh god I've got to do 30-minutes of exercise a day. (Physical activity guidelines, Female)
Promotion	
9. Concomitant relationship	I think from personal experience that there is a relationship between diet, physical activity, and sleep. So, if you eat something that's really sugary or a heavy meal before bedtime you are going to have trouble sleeping. And, if you have been a bit more active during the day that might be helpful, and if you have been outside and had the sunlight. (Female)
10. Benefits beyond weight loss	I find that when it comes to nutrition everything is aimed at lose weight, lose weight, lose weight, don't be fat, lose weight. (Female)
11. Top line messages	I think these are again, your top line messages and then having something, additional tools and give people examples. (Female)
12. Internet/accessibility	So one [web application] from the Ministry of Health. In the back of your mind you would be thinking, well it's got to be right because it's come from experts so you've got trust in what you are actually doing. (Female) There is too much information out there and it's trying to drill down to see what is actually fact. (Female)
13. Use “real people”	That was quite positive; all that advertising was real people that were struggling. (Push Play, Female) Not the pretty, fit looking ones either, they can put people off. (Male)

Nutrition dissemination. Participants identified contradictions between the nutrition guidelines and the messages used to disseminate these guidelines. For example, the current nutrition guidelines state, “eat plenty” of breads and cereals; whereas the Heart Healthy Visual Food Guide states, “eat some”. Some participants queried the Heart Foundation Tick criteria as they described seeing “processed” or “junk food” displaying the Heart Foundation Tick. One participant suggested parents might feel like failures if they or their children do not achieve the prescriptive 5+ A Day criteria.

Physical activity guidelines. The prescriptive phrasing of the physical activity statement “put together at least 30-minutes of physical activity on most if not all days of the week” was disliked. Participants described this statement as having a “negative connotation” and “off-putting”: *“I think you can be quite scary saying you need to exercise for 30-minutes at least every day” (Female)*. However, participants indicated that once they start exercising going beyond 30-minutes is easy to achieve.

Sleep. Participants suggested clarifying how long before bed caffeine, blue-light, and physical activity should be avoided. A sleep routine was considered important, but participants thought going to bed and waking up at the same time each day was prescriptive and unrealistic: *“I think that wake up and go to bed at the same time each day ultimately causes stress” (Female)*.

Application

Nutrition guidelines. Participants reflected on allergies and intolerances. Consequently, participants critiqued the statements that did not account for individual variation. Eating “plenty of breads and cereals” and having “milk and milk products” were considered to be redundant to those unable to eat gluten or lactose.

Nutrition dissemination. Participants observed that the Heart Foundation Tick may be considered “a licence to eat unlimited amounts” of a product. In regards to the 5+ A Day message, there was uncertainty in the fruit-to-vegetable ratio.

Physical activity guidelines. Participants were aware of the guideline “put together at least 30-minutes of moderate intensity physical activity on most if not all days of the week” but most

indicated they did not meet the guideline. A lack of time and motivation were the barriers cited most frequently. Facilitators to being active included social support and being active as part of community. Participants thought the guidelines should encompass information on “how” to be active. Common examples cited by participants were use the stairs instead of the elevator, park further away, and get off the bus stop earlier.

Sleep guidelines. The inter-connected relationship between sleep and other lifestyle behaviours were discussed among participants. The focus on sleep quality, rather than quantity, appealed to participants who recognised there is considerable inter-individual variation in sleep requirements.

Presentation and promotion of guidelines

Nutrition dissemination. All participants were familiar with the 5+ A Day and the Heart Foundation Tick logos. Conversely, participants were not familiar with the Breakfast-eaters logo or the Heart Healthy Visual Food Guide. Nevertheless, participants identified the Heart Healthy Visual Food Guide as an update of the food pyramid.

Physical activity dissemination. Participants recalled the Push Play campaign and liked the diverse range of New Zealanders represented. Participants recalled “kids jumping on trampolines” and “real people” from different cultures being active. Participants suggested using a diverse range of real people in promotional materials.

Overall. Participants liked the idea of promoting nutrition, physical activity, and sleep concurrently, discussing the concomitant relationship between lifestyle behaviours: “*I like the idea of promoting them together. Cause they do. They all impact on each other. They are all inter-related*” (Female). Participants’ recounted personal experiences of how poor sleep, for example, leads to poor nutrition and physical activity choices. The majority of participants did not like the emphasis on body weight and weight loss in the guidelines: “*I think the message I’ve read recently is that it’s a lifestyle, it’s not just about weight loss. Choose to eat well, be active, and sleep because it’s a lifestyle choice*” (Female). They suggested promoting benefits such as increased energy, wellbeing, and productivity.

A tiered messaging approach was suggested for promoting guidelines; using short “top line” messages but also providing access to more in-depth and credible health information.

Participants were uncertain of where to find credible health information and did not know where to locate the nutrition and physical activity guidelines: “*Where are people getting this advice from?*” (Female). Some participants indicated they had previously used exercise or nutrition web-applications. There was consensus in two focus groups that having a list of websites and web-applications endorsed by the Ministry of Health would be useful.

Discussion

The purpose of this formative work was to explore laypersons’ perceptions of nutrition, physical activity, and sleep guidelines and to understand how they want to see these guidelines promoted. Three key themes emerged from the study including (1) wording and comprehension, (2) application, and (3) promotion. The first theme shows that abstract wording and contradictions limited engagement with guidelines, particularly for nutrition. In addition, participants disliked prescriptive physical activity and sleep guidelines. The second theme shows participants preferred statements that emphasise social interaction, mitigate barriers, and are flexible enough to apply to a broad audience. The final theme indicates that lifestyle promotional messages should consider the concomitant relationship between lifestyle behaviours, accessibility of information, benefits beyond weight loss, and use a diverse range of “real people” to promote messages.

In New Zealand, current nutrition and physical activity guidelines stand-alone. In spite of being shown stand-alone sets of nutrition, physical activity, and sleep guidelines, participants reflected on the concomitant relationship between the three-lifestyle behaviours. This finding is supported by research which shows insufficient sleep is implicated with increased caloric consumption and poor dietary habits.^{263; 272} The notion that lifestyle behaviours are inter-connected is supported by accumulating evidence that multiple healthy and multiple unhealthy lifestyle behaviours cluster together.^{204; 205; 206; 256} Despite research to support the synergistic actions of lifestyle behaviours, in public health, lifestyle behaviours are typically promoted in isolation.²⁷³ Taken together with the literature, our findings indicate promoting nutrition, physical activity, and sleep

behaviours concurrently, may provide an appealing strategy to promote lifestyle behaviours to the public.

Despite the cessation of Push Play advertisements in the early 2000s, our findings highlight the success of the campaign through its ongoing recognition and appeal.²⁷⁰ The campaign appeared to resonate with our sample with the majority attributing the success of the initiative to the “real people” depicted in advertisements and promotional materials. Behaviour change theories explain that when individuals observe people similar to themselves performing a behaviour, their confidence in performing the same behaviour increases.^{173; 174} Despite the appeal of the Push Play campaign, the well-established guideline of “30-minutes of moderate-to-vigorous physical activity” was unpopular with participants in the current study. Interestingly, participants preferred less prescriptive physical activity guidelines. Whilst comparative research examining qualitative perceptions of physical activity guidelines is limited, nutrition research shows prescriptive messages may promote a sense of failure.²⁷⁴ Similarly, participants in our study described the prescriptive sleep guideline as unrealistic and likely to cause “stress”. Using non-prescriptive approaches to promote lifestyle behaviours to the public might be more appealing, than current prescriptive approaches. However, as our sample lacked diversity further research might specifically explore the appeal and efficacy of prescriptive versus flexible messaging in a broader sample.

In our study, participants were uncertain of where to access official nutrition and physical activity guidelines and advice. This uncertainty is possibly because the health sector has traditionally served as a gatekeeper of health information.²⁷⁵ However, there is accumulating evidence to show laypersons now seek health information from non-official sources, such as the internet.^{275; 276; 277} Participants in our study indicated it would be useful to know which unofficial sources are endorsed by the Ministry of Health. In their study, Berry et al.²⁷⁶ show laypersons would like to see lifestyle behaviours promoted using styles similar to those used in non-official sources (e.g., magazines, internet). It would therefore be useful to explore the aspects of unofficial sources that appeal to consumers of health information.

The translation of guidelines into appropriate and accessible messages for the public is challenging.²⁷⁸ Our findings offer implications to consider during the development of lifestyle

behaviour messaging. Firstly, placing emphasis on gain-framed messages highlighting the benefits of engaging in healthy behaviours, rather than the risks of not engaging, is likely to be beneficial. Such messages might promote benefits including social support and improved wellbeing. Secondly, our findings show maintaining an appropriate balance between designing guidelines for a broad audience and taking into account individual variation is important. Thirdly, similar to previous research^{279; 280; 281} we show communicating lifestyle behaviours using simple, non-prescriptive, and positive wording is likely to resonate with laypersons. Finally, we show promoting multiple lifestyle behaviours concurrently is a strategy that appeals to our sample.

The findings have implications for policy and practice and make novel contributions to the wider research field. Firstly, by contributing to the limited qualitative research investigating perceptions of physical activity guidelines and secondly, by providing the first evaluation of sleep guidelines. In addition, the study is the first to examine perceptions of guidelines for multiple lifestyle behaviours in the same sample. Nevertheless, while our findings accurately reflect our sample, the sample was small and mainly comprised female participants engaged in the workforce. These limitations preclude the generalizability of our findings. Intervention research exploring the appeal and efficacy of the study findings in diverse samples is warranted.

In spite of the study limitations, the findings offer important insights into a sample of laypersons' perceptions and understanding of public health guidelines. Information from this qualitative study might be used to develop a quantitative instrument for broader dissemination.

What can we learn about lifestyle behaviour change messages from popular books and podcasts?

Preface

This chapter comprises a second formative study aimed at exploring strategies for promoting lifestyle behaviours and wellbeing in a framework for positive health. Similar to public health interventions, the success of popular media depends on the ability to engage and resonate with the public. Thus, a novel formative research approach is adopted in this chapter. Popular lifestyle books and podcasts are reviewed to explore the combinations of nutrition, exercise, sleep, and wellbeing messages promoted in popular books and podcasts. In addition, the philosophies underpinning the behaviours are explored to identify potential messages to incorporate into a positive health intervention. The findings from this review offer novel insights into how messages might be contextualised in a positive health intervention to engage the public. This innovative formative review provides the first systematic assessment of nutrition, exercise, sleep, and wellbeing messages in popular books and podcasts.

Abstract

Background. In public health, formative research is used to develop insights into factors that appeal to a target audience. As success in both public health and popular media is reliant on appealing to the public, exploring popular lifestyle books and podcasts might provide novel insights into behaviour change strategies that appeal to the public.

Aim. The aim of this research is to review the content of popular lifestyle books and podcasts to identify potential strategies to incorporate into behaviour change interventions.

Methods. Synopses of the top-100 books in the *Amazon Health, Fitness, and Dieting* category and the top-50 podcasts in the *iTunes Fitness and Nutrition* were scanned to identify eligible titles. To be eligible, titles were required to focus on nutrition and/or exercise. Eligible titles were reviewed by two researchers who classified the philosophies underpinning the nutrition and/or exercise content of the titles. In addition, the combination of behaviours (nutrition, exercise, sleep, wellbeing) addressed in each title was determined.

Results. In total, 21 books and 35 podcasts met the inclusion criteria. Seven titles promoted isolated behaviours. The combination of nutrition, exercise, and sleep was promoted in 33% of books and in 37% of podcasts. In addition, a further 33% of books and 26% of podcasts endorsed the three lifestyle behaviours and wellbeing concurrently. The most popular nutrition philosophy in both books and podcasts was low carbohydrate/Paleo/Primal. For the exercise philosophies, the current physical activity guidelines were most popular in books and high intensity exercise most popular in podcasts.

Conclusion. The findings indicate promoting multiple lifestyle behaviours concurrently resonates with the public. Behaviour change messages focusing on low sugar and moderate- or high-intensity exercise might also be appealing.

Introduction

There is now substantial evidence to support the benefits of engaging in multiple healthy lifestyle behaviours—such as healthy eating, regular exercise, and quality sleep—for maintaining physical health.^{27; 28; 29; 30} Emerging evidence also shows these lifestyle behaviours are associated with optimal wellbeing.²³⁵ In spite of these benefits, the proportion of individuals meeting recommendations for multiple healthy lifestyle behaviours is low (3-8%).^{205; 241; 243}

Developing effective and sustainable lifestyle behaviour change interventions is challenging as success depends on the ability of the intervention to engage and resonate with the public.

Conducting formative research during intervention development is useful for providing in-depth insights into what is appealing and acceptable to a target population.²⁸² Findings from formative research studies are used to develop interventions which are acceptable, feasible, and likely to influence behaviour change.²⁸² To date, a variety of formative research methods have been documented in the literature including direct observation, in-depth interviews, focus groups, and surveys.²⁸² Despite the benefits and in-depth insights that these research methods provide, they are resource intensive and are frequently restricted to small, homogenous samples.²⁸² Consequently, the ability to develop insights into what a broader spectrum of the population like and find appealing about lifestyle behaviour change is limited.

In recent years, there has been a prolific increase in popular media dedicated to “self-help” lifestyle behaviour change and it seems the public are eager to engage with this advice.^{277; 283} Traditionally, those wanting to better their lifestyles had access to a limited range of self-help books from retailers or libraries. However, with the development of online digital retail stores—such as Amazon.com—the public can now purchase books, in either hard copy or electronic format, from almost anywhere in the world.²⁸⁴ Such easily accessible information about lifestyle behaviour change is not restricted to books alone. Over the last decade, the new digital media phenomena of podcasting has emerged.²⁸⁵ On iTunes—the most popular podcast platform—there is a large and diverse range of free podcasts produced by both experts and laypersons targeting lifestyle behaviour change.²⁸⁵ On one hand, these relatively new digital platforms provide people with access to an abundance of self-help information that is either free or very competitively priced. On the other hand, authors, publishers, and podcast producers are now

required to sell and promote their products in highly competitive markets. The success of lifestyle behaviour change books and podcasts is therefore highly dependent on their ability to be engaging and resonate with the public.

Despite obvious limitations, exploring similarities in the characteristics and philosophies of popular lifestyle books and podcasts may provide novel insights into messages to include in behaviour change interventions. Digital media platforms such as Amazon.com and iTunes host large databases and automatically collect information on consumer purchases and downloads allowing the most popular items to be determined.^{284; 286} Similar to popular books and podcasts, successful public health interventions rely on their ability to engage, appeal, and resonate with the public. The purpose of this formative review is to explore popular lifestyle books and podcasts to identify potential strategies to incorporate into a behaviour change intervention. The review will focus specifically on popular media promoting nutrition, exercise, sleep, and/or wellbeing behaviours. To our knowledge, this is the first study to utilise this novel approach for conducting formative research. The findings from this study will be used to inform the structure and design of an intervention to promote lifestyle behaviour change for positive health.

Methodology

The search for popular lifestyle behaviour change books and podcasts was delimited to *Amazon Bestsellers for Health, Fitness, and Dieting*²⁸⁷ and *iTunes Top Charts for Fitness and Nutrition*.²⁸⁶ Amazon and iTunes charts were selected as they provide a ranked list of popular books and podcasts, respectively. In addition, both platforms are host to the largest databases of registered users (Amazon, $n=294$ million active customer accounts; and iTunes, $n=800$ million).^{284; 288}

Amazon Bestsellers comprises a ranked list of 100 books in the health, fitness, and dieting category (Amazon-100). Similarly, iTunes Top Charts comprises a ranked-list of fitness and nutrition podcasts. The top 50 ranked podcasts were accessed for the purposes of this review (iTunes-50). Amazon-100 and iTunes-50 were accessed on 06 May 2015. Two researchers (KP and CM) independently screened the synopses of the books and podcasts to determine

whether they met the study eligibility criteria. A title was considered eligible if it focused on modifying a nutrition behaviour and/or physical activity behaviour.

Procedures

Once the final list of books and podcasts meeting the criteria was compiled, full text copies of the books were accessed and podcasts downloaded. Two researchers systematically reviewed the content of the titles to identify and classify lifestyle behaviours (nutrition, exercise, or sleep) and wellbeing (connect, take notice, give, and learn).

The criteria described in Table 15 were used to classify the wellbeing and lifestyle behaviours. Briefly, nutrition philosophies were classified into mutually exclusive categories using an adapted version of the dietary classification inventory developed by Katz and Meller.²⁸⁹ Similarly, exercise components were classified into mutually exclusive categories based on the primary exercise philosophy promoted. The exercise classifications that were developed for the purposes of this review were based on the American College of Sports Medicine definitions for: high intensity interval training,²⁹⁰ resistance training,²⁹¹ endurance training,²⁹² and physical activity guideline-recommendations.²⁹³ Wellbeing was classified using the *Five Ways to Wellbeing* framework, a set of evidence-based guidelines developed by the New Economics Foundation.^{65; 171} Finally, sleep was considered addressed if recommendations for improving sleep quality or quantity were provided.

Table 15. Summary of nutrition, exercise, and wellbeing classifications

Classification	Defining characteristics
Nutrition¹	
Low carbohydrate; Paleo; Primal	Emphasis is on whole unprocessed food. Restriction of refined starches, grains, and sugars. ²⁸⁹ Includes Paleo, Primal, and ketogenic diets.
Vegetarian; vegan	Emphasis is on plant-based food. Excludes meat and poultry. ²⁸⁹ Includes vegan diets.
Guidelines-based	Emphasis is on a balanced diet and aligns with current nutrition guidelines. ²⁸⁹
Mediterranean	Emphasis is on plant-based foods including beans and legumes, and whole grains, fish, and limited consumption of meat. ²⁸⁹
Other	Diets that do not meet the above classifications.
Exercise¹	
High intensity exercise	Activities performed at >80% of maximum heart rate or at an intensity described as hard or very hard. ²⁹⁰ High intensity interval training, high intensity circuit training, and CrossFit were included in this category.
Guidelines-based	The promotion of at least 30 minutes of moderate intensity activity (e.g., walking, cycling, and swimming) on most, if not all, days of the week. ²⁹³
Endurance	Represents high volume, low intensity exercise. ²⁹² Includes half marathon, marathon, and ultra-marathon training.
Resistance training	Activities which utilised free weights, machine weights, body weight, or other weights (including household items) to increase muscular strength, power, or endurance. ²⁹¹
Sleep	Emphasis on either sleep quality or quantity. ⁶⁵
Wellbeing²	
Connect	Relationships with others including family, friends, and colleagues. ⁶⁵
Take notice	Mindfulness, savouring, and reflection. ⁶⁵
Give	Participation in social and community life. ⁶⁵
Learn	Continuation of learning and trying new things. ⁶⁵

¹Categories are independent; ²Categories are not independent

Results

In total, 15 podcasts and 55 books did not meet the inclusion criteria (Figure 9). A further 20 books were identified as duplicates. A total of 21 books and 35 podcasts were included in the final analysis.

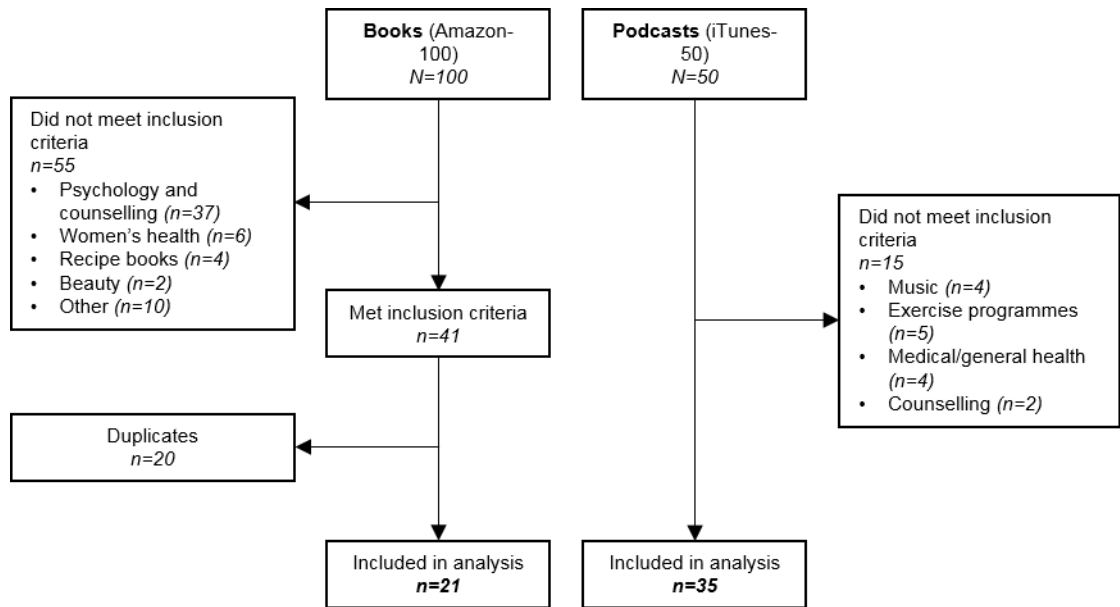


Figure 9. Summary of books and podcasts included in review

Popular philosophies and common messages

Combinations

Table 16 shows the majority of the titles promoted multi-component messages (books $n=18$, 86%; podcasts $n=31$, 91%). Just three books and four podcasts promoted isolated messages.

Table 16. Combinations of nutrition, exercise, sleep, and wellbeing addressed in books and podcasts.

Number of components addressed (nutrition, exercise, sleep, or wellbeing)	Books (n=21)	Podcasts (n=35)
One component	n=3, 14%	n=4, 11%
Nutrition	n=3, 14% ^{294; 295; 296}	n=1, 3% ²⁹⁷
Exercise		n=3, 9% ^{298; 299; 300}
Two components	n=4, 19%	n=9, 26%
Nutrition, exercise	n=1, 5% ³⁰¹	n=3, 9% ^{302; 303; 304}
Nutrition, sleep	n=3, 14% ^{305; 306; 307}	n=2, 6% ^{308; 309}
Nutrition, wellbeing		n=2, 6% ^{310; 311}
Exercise, sleep		n=2, 6% ^{312; 313}
Three components	n=7, 33%	n=13, 37%
Nutrition, exercise, sleep	n=5, 24% ^{314; 315; 316; 317; 318}	n=6, 17% ^{319; 320; 321; 322; 323; 324}
Nutrition, exercise, wellbeing	n=1, 5% ³²⁵	n=6, 17% ^{326; 327; 328; 329; 330; 331}
Nutrition, sleep, wellbeing		n=1, 3% ³³²
Exercise, sleep, wellbeing	n=1, 5% ³³³	
Four components	n=7, 33%	n=9, 26%
Nutrition, exercise, sleep, wellbeing	334; 335; 336; 337; 338; 339; 340	341; 342; 343; 344; 345; 346; 347; 348; 349

Philosophies

Table 17 shows low carbohydrate/Paleo/Primal was the most common nutrition philosophy promoted in both books and podcasts. For exercise, high-intensity was most common in podcasts, whilst the guidelines-based philosophy was most common in books.

Nutrition. Unprocessed, whole, and natural foods were emphasised across the popular titles. Similarly, emphasis was placed on restricting the consumption of sugar. There were diverging recommendations for fat. Titles in the vegetarian and guidelines-based philosophies recommended low-fat products. Vegetarian and guidelines-based titles also focused on messages such as “calories in versus calories out”. In contrast, more popular low carbohydrate (including Paleo and Primal) titles specifically recommended higher fat foods (e.g., coconut oil). Rather than concentrating on calories, the titles emphasised foods to eat and avoid.

Exercise. High intensity exercise was a popular message in podcasts. Promoting high intensity exercise was more common in low carbohydrate, Paleo, and Primal titles. Overall however, 20- to 40-minutes of moderate intensity exercise was the exercise message most frequently emphasised. A variety of exercise modalities were recommended.

Sleep. Strategies for improving sleep included sleeping in a darkened room,^{339; 340} exercising during the day,^{305; 339} creating a sleep routine,^{317; 339} managing stress,^{314; 337} getting exposure to natural light during the day,³³⁹ and avoiding blue light,^{305; 306; 314; 339} intense exercise,³⁰⁶ and caffeine^{305; 306; 336} before bedtime. Sleep was largely included in books that promoted low carbohydrate, Paleo, and Primal diets.

Wellbeing. The predominant wellbeing initiatives addressed were take notice and connect. Examples of taking notice included mindfulness and meditation,^{325; 327; 334; 336; 337; 338; 340; 344; 345; 348} reflecting in journals,^{303; 325; 338; 339} slowing down,^{325; 332; 334} and connecting with nature.^{303; 320; 325; 331; 341} Examples of connecting included focusing on relationships^{325; 334; 335; 339} and providing and accepting social support.^{325; 338; 348}

Table 17. Summary of lifestyle behaviours, philosophies, and wellbeing addressed in books and podcasts.

Classification	Books (n=21)	Podcasts (n=35)
Total nutrition	n=20, 95%	n=30, 86%
Low carbohydrate; Paleo; Primal	n=11, 52% 294; 295; 296; 305; 306; 307; 316; 317; 336; 340; 341	n=17, 49% 297; 302; 310; 319; 320; 323; 324; 326; 330; 332; 341; 342; 344; 345; 347; 348; 349
Vegetarian	n=2, 10% 334; 337	n=2, 6% 311; 329
Guidelines-based	n=1, 5% 325	n=5, 14% 304; 309; 321; 328; 331
Mediterranean	n=1, 5% 335	-
Other	n=5, 24% 301; 315; 318; 338; 339	n=6, 17% 303; 308; 322; 343; 346; 350
No nutrition	n=1, 5% 333	n=5, 14% 298; 299; 300; 312; 313
Total exercise	n=15, 71%	n=29, 83%
High intensity exercise	n=3, 14% 315; 340; 341	n=16, 46% 302; 312; 319; 321; 323; 324; 326; 328; 330; 341; 342; 344; 345; 347; 348; 349
Guidelines-based	n=12, 57% 301; 316; 317; 318; 325; 333; 334; 335; 336; 337; 338; 339	n=7, 20% 303; 304; 320; 322; 327; 331; 346
Resistance training		n=3, 9% 298; 299; 300
Endurance		n=3, 9% 313; 329; 343
No exercise	n=6, 29% 294; 295; 296; 305; 306; 307	n=6, 17% 297; 308; 309; 310; 311; 332
Total sleep	n=16, 76% 305; 306; 307; 315; 316; 317; 318; 333; 334; 335; 336; 337; 338; 339; 340; 341	n=20, 57% 308; 309; 312; 313; 319; 320; 321; 322; 323; 324; 332; 341; 342; 343; 344; 345; 346; 347; 348; 349
No sleep	n=5, 24% 294; 295; 296; 301; 325	n=15, 43% 297; 298; 299; 300; 302; 303; 304; 310; 311; 326; 327; 328; 329; 330; 331
Total wellbeing	n=9, 43%	n=18, 51%
Connect	n=6, 29% 325; 333; 334; 335; 338; 339	n=13, 37% 311; 326; 328; 329; 330; 332; 341; 342; 343; 346; 347; 348; 349
Take notice	n=9, 43% 325; 333; 334; 335; 336; 337; 338; 339; 340	n=18, 51% 310; 311; 326; 327; 328; 329; 330; 331; 332; 341; 342; 343; 344; 345; 346; 347; 348; 349
Give	n=2, 10% 325; 333	
Learn	n=2, 10% 325; 333	n=3, 9% 327; 332; 346
No wellbeing	n=12, 57% 294; 295; 296; 301; 305; 306; 307; 315; 316; 317; 318; 341	n=17, 49% 297; 298; 299; 300; 302; 303; 304; 308; 309; 312; 313; 319; 320; 321; 322; 323; 324

Discussion

In this formative work, we used an innovative approach to explore lifestyle behaviour change messages that may resonate with the public. Key findings from this review show the majority of book and podcast titles addressed nutrition (books $n=20$, 95%; podcasts $n=30$, 86%) and exercise (books $n=15$, 71%; podcasts $n=29$, 83%); whilst fewer addressed sleep (books $n=16$, 76%; podcasts $n=20$, 57%) and wellbeing (books $n=9$, 43%; podcasts $n=18$, 51%). Our data shows nutrition, exercise, and sleep were promoted concurrently in seven (33%) books and 13 (37%) podcasts. In addition, a further seven (33%) books and nine (26%) podcasts endorsed the three lifestyle behaviours and wellbeing concurrently.

Exploring specific philosophies and common messages of popular titles provides insight into how nutrition, exercise, sleep, and wellbeing messages might be contextualised to engage the public. Reducing sugar and processed foods, for example, was a popular message across the books and podcasts, with low carbohydrate/Paleo/Primal emerging as the most popular philosophy. Emerging research suggests that in contemporary cultures increased value is placed on the consumption of unprocessed and natural foods.^{351; 352; 353} Not only is this message popular, but scientific evidence supporting the benefits of diets comprising low sugar and processed foods is increasing.¹⁹¹ Likewise, high intensity training might be used to complement traditional moderate physical activity messages. Experimental studies show high intensity exercise is a time-effective alternative to moderate intensity physical activity^{354; 355} and is also perceived to be more enjoyable.³⁵⁶ Furthermore, integrating sleep strategies and wellbeing initiatives into behaviour change interventions may enhance their acceptability and effectiveness. Research shows individuals are more likely to make sustainable behaviour change when they receive social support.^{357; 358} Likewise, mindfulness is associated with increased engagement in positive health behaviours.^{359; 360} Future research investigating the public's acceptability of these popular messages is warranted.

A pertinent finding to emerge from our review was that the majority of titles promoted lifestyle behaviours concurrently, with just seven titles promoting stand-alone behaviours. This contrasts current public health initiatives where the tendency is to promote lifestyle behaviours in isolation.^{32; 251; 273} Evidence to support the promotion of multiple lifestyle behaviours is

accumulating, however. For example, cross-sectional research shows healthy and unhealthy lifestyle behaviours cluster.^{204; 205; 206; 256} Findings from these clustering studies indicate individuals who are meeting recommendations for one lifestyle behaviour are more likely to be meeting recommendations for other behaviours, and vice versa. Recent work indicates adopting multiple healthy lifestyle behaviours is also important for optimal wellbeing.²³⁵ Thus, framing lifestyle behaviour messages around the adoption of concurrent healthy lifestyle behaviours may have relevance for not only improving health, but also wellbeing.

Whole lifestyle approaches were consistently emphasised across popular self-help titles, indicating this is a message that resonates with the public. Prochaska et al.³³ have previously documented the benefits of targeting concurrent lifestyle behaviours.³³ At the individual level, successfully improving one lifestyle behaviour may lead to the confidence and self-efficacy to improve other behaviours.³³ At the population level, targeting concurrent behaviours is likely to be both an efficient and cost-effective approach.³³ Experimental research should investigate whether promoting nutrition, physical activity, sleep, and wellbeing, concurrently, is a viable option for promoting positive health.

In the current study, we adopted an innovative approach to identify novel ways to promote lifestyle behaviour messages. To our knowledge, this review is the first to explore the combination of nutrition, exercise, sleep, and wellbeing in popular media. However, it is important to bear in mind the limitations of the current research. Firstly, it is beyond the scope of the study to analyse the scientific evidence underpinning the philosophies promoted. Secondly, we cannot determine whether individuals actioned the advice provided in the titles reviewed. Finally, the demographics of those purchasing and downloading the titles are unknown, limiting the generalizability of our findings. Nonetheless, the findings have application for the development of initiatives promoting lifestyle behaviour change. Further research exploring the application of these findings is strongly recommended.

Conclusion

Popular lifestyle books and podcasts have been reviewed to identify behaviour change messages that are engaging and resonate with the public. Using this innovative approach, we

found whole lifestyle approaches were consistently emphasised across the titles. Our findings also highlight the popularity of philosophies that promote low sugar, limited processed food, moderate physical activity, and high intensity exercise. Future research might consider exploring the implications of promoting nutrition, physical activity, sleep, and wellbeing behaviours concurrently. Taken together our research findings provide insight into potential messages to incorporate into lifestyle behaviour change interventions.

Development and utility of BE Well: A tool to assess satisfaction with positive health behaviours

Preface

Multiple wellbeing and lifestyle behaviours are promoted concurrently in popular media (Chapter 6). However, public health initiatives integrating the promotion of concurrent wellbeing and lifestyle behaviours are limited. Based on the convergence of findings from the previous studies, the final series of studies (Chapter 7-8) explores the implementation of positive health.

To meet the needs of individuals and population groups the ability to prioritise the most appropriate wellbeing or lifestyle behaviours would be beneficial. Individuals are unlikely to modify wellbeing or lifestyle behaviours unless they consider the behaviours to be a high-priority for change. However, no instrument to assess satisfaction across multiple wellbeing and lifestyle behaviours, concurrently, is available. The objective of this chapter was to develop a tool comprising multiple positive health behaviours to identify quickly (a) behaviours individuals are satisfied with and (b) high-priority goals for positive health behaviour change. In addition, the utility of the tool is assessed.

Abstract

Background. Positive health comprises high levels of health and wellbeing. Developing initiatives integrating multiple wellbeing and lifestyle behaviours is likely to be important for promoting positive health. An instrument to identify quickly the positive health behaviours individuals are most, or least, satisfied with would have relevance within the constraints (e.g., time) of clinical and population-level settings. Findings can inform interventions targeting high-priority behaviours for change.

Objective. The aim of this study is to develop a tool comprising multiple positive health behaviours to identify quickly (a) behaviours individuals are satisfied with and (b) high-priority behaviours for change. A secondary aim of this study was to assess the utility of the tool.

Methods. The BE Well (Brief Evaluation of Wellbeing) tool was developed by an expert panel drawing on literature from positive psychology and public health research. A sample of participants were recruited to test the reliability using a convenience-sampling strategy. Two-day test-retest reliability was calculated for each item using Pearson product-moment correlation coefficient. A second sample of adults were recruited to investigate the utility of BE Well. For each BE Well item, descriptive statistics were used to calculate participants' satisfaction.

Results. BE Well comprised 21-items to assess nutrition, physical activity, sedentary behaviour, sleep, relationships with others, mindfulness, giving, hobbies and interests, and work and finance. All items, with the exception of three, were reliable in a sample of 27 adults. The median and mean reliability scores for the audit were $r = 0.77$ and $r = 0.73$, respectively. Testing the utility of the tool in a sample of 27 participants shows the majority of participants identified they should eat less sugar and processed food (89%), engage in less screen-time (85%), spend more time outdoors (85%), and do more exercise (81%).

Conclusion. BE Well is the first instrument to assess the satisfaction and priority placed on changing multiple wellbeing and lifestyle behaviours.

Introduction

In 1946 the World Health Organization defined health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (p. 1315).¹ Although this holistic and positive definition of health continues to be used today, initiatives explicitly designed to promote positive health are limited.³⁸ Health systems in most societies operate within a deficit model,³⁸ with a focus on disease treatment and harm reduction.^{38; 57} However, the escalating costs associated with this deficit model of health are unsustainable. In New Zealand, for example, healthcare expenditure has increased by NZ\$2,404 per person over the past 50-years.⁸ Reorienting the deficit-based health system toward a positive health framework may provide a cost effective solution to the current approach of treating poor health.³⁶¹

A positive health framework integrates initiatives from the disciplines of positive psychology and public health and is ideal for promoting optimal health and optimal wellbeing.^{3; 14} Positive psychology research has identified connecting with others, being mindful, giving, and learning are important for optimal wellbeing.⁶⁵ Likewise, public health research shows healthy lifestyle behaviours—including nutrition, physical activity, and sleep—are associated with both optimal health^{27; 28; 29; 30} and optimal wellbeing.²³⁵ There is also evidence to indicate lifestyle behaviours cluster together and those who engage in multiple healthy lifestyle behaviours are more likely to have optimal wellbeing.²⁵⁶ Furthermore, a recent prototype analysis of laypersons’ definitions of flourishing (viz. optimal wellbeing) highlights the concomitant role of lifestyle behaviours, social relationships, and personal interests for optimal wellbeing.¹⁷⁵ Taken together, this research highlights a range of wellbeing and lifestyle behaviours that are important for positive health.

Initiatives incorporating multiple wellbeing and lifestyle behaviours may provide an effective strategy for promoting positive health. However, positive health initiatives would likely be more effective if the behaviours promoted resonate with the intended audience. Behaviour change theories indicate action-oriented messages are unlikely to resonate, unless individuals consider the behaviour a high-priority for change.^{362; 363} Furthermore, success in changing behaviours is more likely to be achieved when target audiences actively participate in identifying their own high-priority goals.³⁶³ Having an instrument to identify quickly the positive health behaviours individuals are most, or least, satisfied with would have relevance within the constraints (e.g.,

time) of both clinical and population-level settings. Findings can be used to inform interventions targeting high-priority behaviours for change.

Although psychology instruments are available to measure satisfaction across multiple domains of wellbeing,³⁶⁴ these instruments neglect to consider lifestyle behaviours. On the other hand, instruments to identify priority-goals for change are available in public health.¹⁷⁴ However, public health instruments measure isolated, rather than multiple, lifestyle behaviours and also neglect to consider wellbeing. To our knowledge, there are currently no instruments available to assess quickly the satisfaction and priority placed on changing multiple wellbeing and lifestyle behaviours. The overarching aim of this study is to develop a tool comprising multiple positive health behaviours to identify quickly (a) behaviours individuals are satisfied with and (b) high-priority behaviours for change. A secondary aim of this study was to assess the utility of the tool. We anticipate that the tool will have application for practitioners promoting positive health in both clinical- and population-level settings.

Methods

The methods comprise two sections describing the development and utility of the tool. Auckland University of Technology Ethics Committee grant ethical approval to conduct the study on 24 August 2015 (AUTEC 15/263).

Development of BE Well

The BE Well (Brief Evaluation of Wellbeing) tool was developed to assess individuals' satisfaction with multiple wellbeing and lifestyle behaviours in order to identify high-priority behaviours for change. BE Well was developed by a panel of researchers with expertise in public health, physical activity, nutrition, wellbeing, and positive psychology. Literature from positive psychology and public health were drawn on to identify possible behaviours for inclusion. The literature included work on the clustering of lifestyle behaviours for health^{204; 205; 206} and optimal wellbeing,²⁵⁶ laypersons' perceptions of wellbeing,¹⁷⁵ and the *Five Ways to Wellbeing*.^{65; 246} For a behaviour to be included in the instrument, panel consensus was required. In total 21-items assessing a range of wellbeing and lifestyle behaviours were agreed on (Table 18).

Table 18. Behaviours assessed in BE Well

Lifestyle behaviours	Wellbeing behaviours
<ul style="list-style-type: none"> • Exercise • Time sitting • Screen-time • Unprocessed food • Processed food and sugar • Alcohol • Sleep 	<ul style="list-style-type: none"> • Time outdoors • Time with spouse/partner • Time with parents • Time with children • Time with friends • Time with colleagues • Time and attention • Contributing to household • Hobbies and interests • Time alone • Rest and relaxation • Play and fun • Work • Money/financial matters

In contrast to current practice in physical activity literature, “*time sitting*” and “*screen-time*” were treated as two independent categories. This decision was made, as screen-time contributes to poor sleep²⁰⁰ and might also displace time interacting with others (e.g., partner, children, etc.).

Satisfaction with each item was assessed on a 9-point scale (1-9). The question “*Please indicate how comfortable you felt with these different areas of your wellbeing over the past four-weeks*” headed the scale. The scale was anchored by 1 (*a lot less*), 5 (*about right*), and 9 (*a lot more*) (Appendix G). The question (*how comfortable you felt with*) was chosen to take into account both the satisfaction and the priority placed on changing behaviours. Behaviour change theories suggest that if an individual indicates “less” or “more” they are likely to be either contemplating or planning to change the behaviour.¹⁷³ Conversely, if an individual has no interest or does not recognise the need to change a behaviour they are likely to indicate the behaviour is “about right”.¹⁷³

Wording and comprehension of the BE Well tool were tested in a small sample of eight adults and minor adjustments were made accordingly.

Reliability of BE Well

Participants were recruited through the researchers’ networks using a snowball technique. To determine test-retest reliability of BE Well, the tool was completed by participants two-weekdays apart. Reliability of the items comprising the tool were analysed using Pearson product-moment correlation co-efficient. Cohen’s *r*-values were used to determine the strength of the correlations.

Results

In total 27 participants completed the reliability study. The median and mean reliability scores for the audit were $r = 0.77$ and $r = 0.73$, respectively. The findings show strong correlations for all items with the exception of the items measuring unprocessed food ($r = 0.47$; medium), processed food ($r = 0.35$; medium), and exercise ($r = 0.23$; weak) (Table 19).

Table 19. Test-retest reliability of the BE Well tool ($n=27$)

Item	Correlation (r)
Exercise	0.22
Sugar and processed food	0.35
Unprocessed food	0.47 *
Time outdoors	0.54 **
Screen-based activities	0.60 **
Play and fun	0.66 **
Time with parents	0.73 **
Time with friends	0.75 **
Sleep	0.76 **
Sitting	0.76 **
Contribution to household	0.77 **
Time alone	0.78 **
Rest and relaxation	0.78 **
Hobbies	0.79 **
Time helping others	0.82 **
Money	0.86 **
Alcohol	0.87 **
Work	0.90 **
Time with spouse	0.90 **
Time with children	0.98 **
Time with colleagues	0.98 **

* $p < 0.05$; ** $p \leq 0.001$

Utility of BE Well

Study design

Participants completed the BE Well tool prior to beginning a four-week intervention. For the purposes of this study, only the BE Well data is reported on.

Convenience-sampling methods were employed to recruit 30 participants into a positive health feasibility study. Participants were required to be age 20 years or over. There were no further eligibility criteria. Due to a low initial response rate, recruitment occurred in two phases (Phase 1 and Phase 2).

Phase 1. Participants were recruited from a white-collared workplace setting. The study was advertised for two-weeks on the staff intranet site (14 September to 26 September 2015). Individuals contacted the lead researcher directly to express interest in the study and were emailed a link to the study website, a participant information sheet, and consent form. To participate, individuals were required to complete the consent form and returned it to the research team. Individuals received two follow-up reminders to return their consent forms.

Phase 2. A web-based recruitment strategy was employed. The study was advertised on social media (Facebook, 2 November 2015) and a snowball technique was used to recruit participants. Participants were directed to the study website that contained detailed study information, a participant information sheet, and a consent form. To participate individuals were required to complete a consent form and returned it via email to the research team.

The BE Well tool was administered to assess satisfaction across multiple wellbeing and lifestyle behaviours and to identify high-priority behaviours for change. Microsoft Excel (Microsoft Office, 2013) was used to calculate descriptive statistics. To examine the distribution for each item comprising the BE Well tool, responses were collapsed into three categories: should do less (response scale 1-4), about right (response scale 5), and should do more (response scale 6-9).

Results

Of the 31 participants who consented to the study, 27 participants (20% male) completed the BE Well tool. The mean age of participants was 35 years. In total, 85% of the sample were of European ethnicity (11% Maori/Pacific; 4% Asian).

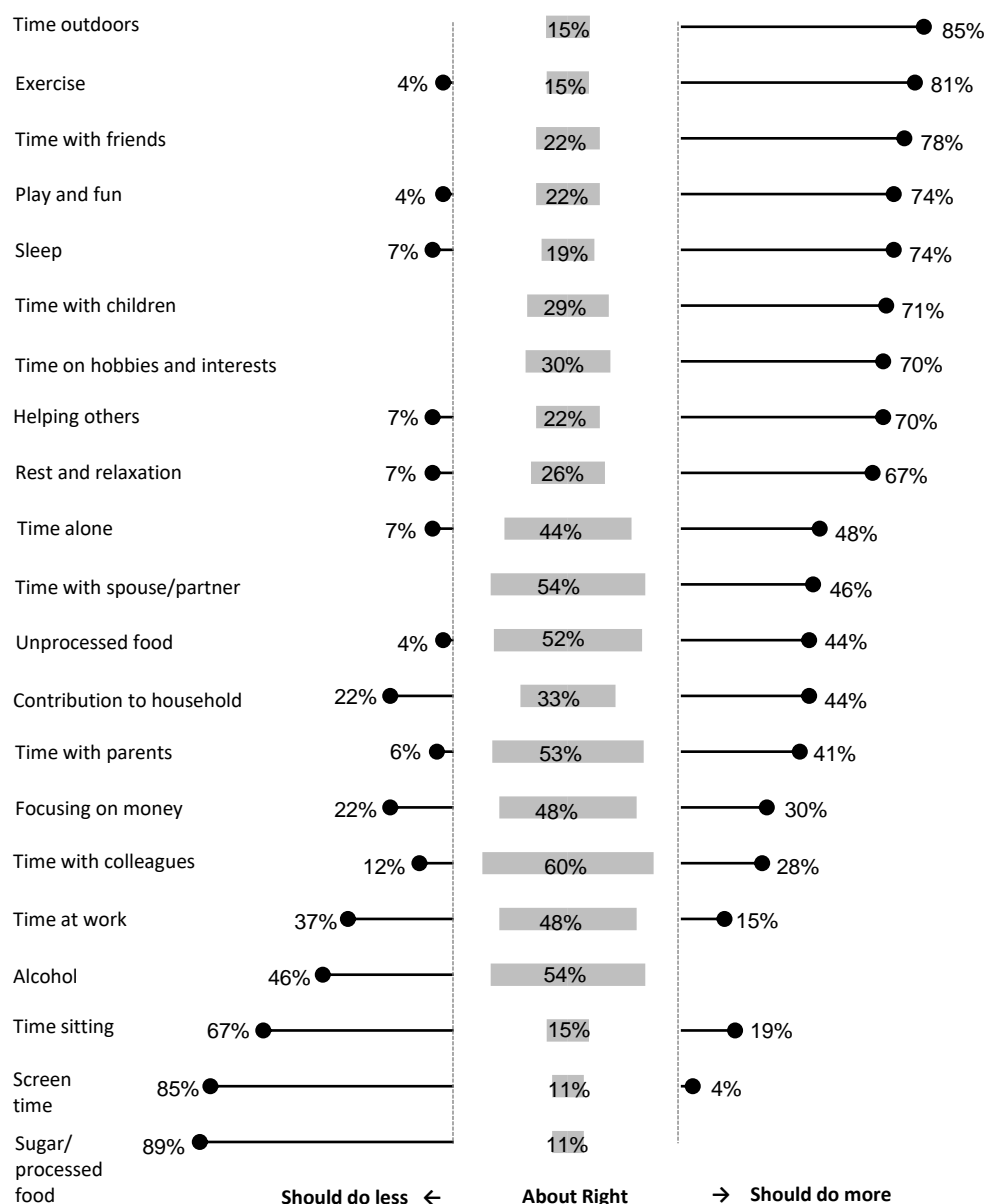


Figure 10. Proportion of the sample indicating they should do less, were about right, or should do more for each item assessed in the BE Well tool (n=27)

Figure 10 shows the majority of participants identified a desire to eat less sugar and processed food (89%), spend less time on screens (85%), spend more time outdoors (85%), and do more exercise (81%). Participants indicated they want to spend more time with friends (78%), however, they indicated that the time they spend with their spouse/partner (54%), parents (53%), and work colleagues (60%) was about right.

Discussion

To promote positive health, it would be useful to identify specific wellbeing and/or lifestyle behaviours to prioritise. To our knowledge, BE Well is the first instrument, comprising multiple wellbeing and lifestyle behaviours, that can be used to quickly identify positive health behaviours individuals are most or least satisfied with. Our findings show the majority of items in the tool were reliable in a sample of 27 adults (median: $r = 0.77$; mean: $r = 0.73$). Investigating the utility of BE Well in an intervention setting shows the majority of participants identified they should eat less sugar and processed food, engage in less screen-time, spend more time outdoors, and do more exercise.

Comparable research investigating satisfaction across multiple wellbeing and lifestyle behaviours is limited. Perhaps unsurprisingly, when implementing the BE Well tool most participants in our sample indicated they want to spend less time on screens (85%) and more time outdoors (85%). These findings have important implications for positive health, as exposure to artificial and natural light influences sleep rhythms.¹⁹⁹ Emerging research shows using light emitting devices prior to bed increases evening alertness, delays sleep onset, and reduces next day alertness.^{199; 200} In contrast, exposure to natural light during the day is important for regulating circadian rhythms.¹⁹⁴ Findings from a recent study show exposure to the natural environment attenuated insufficient sleep.³⁶⁵ Spending more time outdoors also offers opportunities to be active. Conversely, screen use is associated with increased levels of sedentary behaviour. Action-oriented messages promoting ways to decrease screen-time and increase time spent outdoors should be considered.

Findings from a previous study investigating laypersons' perceptions of optimal wellbeing show healthy lifestyle behaviours were key to how the public defined their wellbeing.¹⁷⁵ In addition, important pathways to wellbeing were identified and included healthy lifestyle behaviours (including healthy eating, physical activity, and sleep), social relationships, and personal interests.³⁶⁶ Whilst this previous evidence shows people consider healthy lifestyle behaviours important to their wellbeing, in our study most of the sample were not satisfied with the amount of exercise they were doing or processed foods they were eating. Our findings suggest focusing

on these lifestyle behaviours may be important in a positive health intervention. However, in light of the low reliability of these items, further research is needed.

Behaviour change theories suggest individuals are more likely to modify a behaviour when they consider the behaviour to be a high-priority for change.³⁶³ The subjective nature of BE Well is an advantage, as respondents can weight behaviours in any way they choose. BE Well, therefore, allows the most salient positive health behaviours to be identified. Compared with generic interventions, evidence shows tailored behaviour change interventions are likely to engage individuals.^{367; 368} The BE Well tool has relevance in a clinical setting as the tool can be administered to quickly identify and prioritise behaviours an individual is least satisfied with. Similarly, BE Well can be administered to population groups (e.g., workplaces) to identify the behaviours pertinent for change within the specific population. Behaviour change researchers have attributed unexpected improvements in control groups to baseline assessments of behaviour change.^{369; 370} BE Well therefore has potential to be used as a brief intervention to raise awareness of wellbeing and lifestyle behaviours important for positive health. Further research investigating the application of BE Well is strongly recommended.

The integration of multiple wellbeing and lifestyle behaviours in the BE Well tool makes a novel contribution to the literature. However, these findings should be considered in the context of the study limitations. Firstly, reliability of the nutrition and exercise items were low to moderate indicating further refinement of these items is necessary. Closer examination of responses to the unprocessed and processed food items revealed wording may have attributed to the decreased reliability, with some participants moving to mirror opposite ends of the scales between trials (e.g., indicating they want to eat a lot less to a lot more sugar and processed foods). Further iterations of the instrument should focus on the development of wording and comprehension of these items. Secondly, carry-over or practice effects may influence test-retest reliability. Finally, the sample sizes of studies were small and homogenous; the results may not be generalizable to wider groups. For future applications, it is recommended that the BE Well tool is assessed for reliability and validity in the population intended for study.

Acceptability and feasibility of a positive health intervention

Preface

There is currently a paucity of academic research integrating the promotion of wellbeing and multiple lifestyle behaviours in practice. In this chapter (Chapter 8), an innovative positive health intervention was developed based on the convergence of findings from the previous studies.

Specific findings from this research that guided the development of the intervention were:

- Preference for non-prescriptive approaches (Chapter 5)
- Social support (Chapter 5)
- Consideration of individual variation (Chapter 2 and Chapter 5)
- Convergence of findings to support promoting multiple lifestyle behaviours, concurrently (Chapters 2, 4-6)

The acceptability and feasibility of the novel positive health intervention are explored.

Abstract

Background. Although the promotion of wellbeing is explicit in policy, most initiatives in public health focus on preventing disease. Consequently, there are limited examples of interventions targeting wellbeing and lifestyle behaviours to promote positive health.

Aim. The aim of this study is to evaluate the acceptability and feasibility of *N=ONE*; an intervention integrating multiple wellbeing and lifestyle behaviours. The intervention was non-prescriptive and completed in pairs over four-weeks.

Methods. Participants were recruited into a feasibility study using convenience-sampling methods. Participants' wellbeing and lifestyle behaviours were rated by themselves and a partner using the BE Well audit tool. Participants completed a four-week intervention comprising weekly wellbeing and/or lifestyle challenges; challenges were devised by participants and their partners based on their BE Well audit results. Weekly challenges were submitted to the research team and were coded into pre-determined wellbeing and lifestyle categories using directed content analysis. To explore acceptability, all participants were invited to take part in a post-intervention telephone interview. Qualitative content analysis was used to code and categorise the telephone interview transcripts into sub-themes and themes.

Results. Thirty-one participants were recruited into the study. In total 89 challenges were submitted by 25 participants. The majority (59%) of challenges focused on nutrition, sleep, and exercise. Telephone interviews ($n=25$) show strengths of the intervention include the BE Well audit tool, tailored challenges, weekly surveys, and weekly emails. Limitations include the timing of the intervention, penalty, and limited interactive content. Polarising feedback was given for the social support component and the length of the intervention.

Conclusion. With modifications, *N=ONE*, or a similar intervention integrating wellbeing and lifestyle behaviours, is likely to be an acceptable and feasible intervention for promoting positive health.

Introduction

In most societies, including New Zealand, health systems operate within a deficit health model.³⁸ Within this model the emphasis, both fiscally and through practice, is primarily on the treatment of disease.³⁸ In spite of specific reference to the promotion of wellbeing in policy documents,² public health initiatives explicitly designed to promote wellbeing are limited. In New Zealand, for example, the government's Health Promotion Agency was established to "promote health and wellbeing and encourage healthy lifestyles".⁵ Yet of New Zealand's annual \$15.6 billion healthcare budget,⁶ the Health Promotion Agency receives only \$25-\$33 million,⁶ of which the bulk is spent on harm reduction (e.g., reducing alcohol, gambling, and smoking).⁵ There is no doubt that treatment of disease is important. However, the escalating costs of treating poor health are unsustainable.

In contrast to deficit health models, a positive health framework seeks to promote health as a "state of complete physical, mental, and social wellbeing and not merely the absence of disease".^{1; 3; 14} Promoting this holistic and positive notion of health may provide a cost effective alternative to the current approach of treating poor health.³⁶¹ In positive psychology, initiatives explicitly designed to promote optimal wellbeing at a population level are emerging. These initiatives target important dimensions of subjective and psychological wellbeing, such as connecting with others, mindfulness, giving, and learning.^{21; 23; 24; 25} While positive psychology makes an important contribution to the promotion of positive health, it is our view that the discipline has neglected to consider and promote lifestyle behaviours.

Research indicates lifestyle behaviours—such as healthy eating, regular physical activity, and sufficient sleep—are important for optimal health^{27; 28; 29; 30} and optimal wellbeing.^{235; 256} Public health guidelines and policies have been developed to promote nutrition and physical activity behaviours.²⁴⁷ However, the emphasis in public health is on alleviating health risk, rather than promoting positive health. The development of guidelines and promotion of lifestyle behaviours are therefore guided by the minimum dose to prevent disease.²⁷ Furthermore, in spite of evidence to support the clustering or co-occurrence of healthy and unhealthy behaviours,^{204; 205; 256} lifestyle behaviours are promoted in isolation.^{251; 273} In order to reorient public health toward

an overarching framework for positive health, a concerted effort to integrate the promotion of wellbeing and multiple lifestyle behaviours should be considered.

In recognition of the need for developing an inter-disciplinary approach for promoting positive health, *N=ONE: Be your own Experiment* was developed. *N=ONE* is a positive health intervention which integrates positive psychology and public health initiatives to promote wellbeing and lifestyle behaviours. Prior to implementing a large-scale trial to determine the effectiveness of *N=ONE*, it is necessary to determine the feasibility and acceptability of the intervention.³⁷¹ Feasibility studies are useful for identifying potential problems with the recruitment, acceptability, implementation, and practicability of an intervention.³⁷¹ Early identification of issues or problems with interventions is important, as public health resources and funding are limited. The overarching aim of this study was, therefore, to evaluate the acceptability and feasibility of *N=ONE*; a novel intervention designed to promote positive health.

Methods

Study design

This research reports on qualitative data collected from a positive health feasibility study. Auckland University of Technology Ethics Committee granted ethical approval to conduct the study on 24 August 2015 (AUTEC 15/263).

Participants and setting

Convenience-sampling methods were employed to recruit participants into the feasibility study. Participants were required to be over 20 years. There were no further eligibility criteria. Participation in the study was voluntary and no incentives were provided. Due to a low initial response rate, recruitment occurred across two settings (Phase 1 and Phase 2).

For Phase 1, participants were recruited from a white-collared workplace setting. The study was advertised for two-weeks on the staff intranet site during September 2015. Individuals contacted the lead researcher to express interest in the study and were emailed a link to the study website, a participant information sheet, and consent form. To participate individuals were

required to complete the consent form and returned it to the research team. Individuals received two follow-up reminders.

For Phase 2, a web-based recruitment strategy was employed. The study was advertised on social media (Facebook, 2 November 2015) and a snowball technique was used to recruit participants. Participants were directed to the study website that contained information about the study, a participant information sheet, and a consent form. To participate individuals were required to complete the consent form and returned it via email to the lead researcher.

Intervention description

N=ONE: Be your own Experiment was the positive health intervention developed. The name reflects the intervention premise that individuals should try to make small tailored lifestyle changes to determine what works for them. The initiative comprised a four-week game to promote and raise awareness of evidence-based behaviours important for positive health (Figure 11).

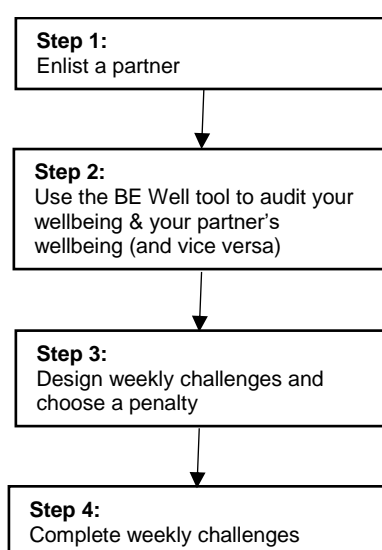


Figure 11. Overview of *N=ONE* intervention

To complete the game participants were to enlist a partner (e.g., spouse, friend, family member, etc.). The rationale for including a social support component was based on previous research which shows motivation and adherence to change are increased with social support.^{357; 358; 372}

Participants' partners were encouraged to participate in the intervention, but were not required to complete the research component.

Participants used the BE Well (Brief Evaluation of Wellbeing) tool to audit their personal wellbeing and their partners wellbeing, and vice versa (Appendix G). The BE Well tool comprises 21-items and is used to understand the priority given to changing different wellbeing and lifestyle behaviours. Behaviours include nutrition, physical activity, sedentary behaviour, sleep, screen-time, relationships with others, mindfulness, giving, hobbies and interests, and work and finance. The behaviours audited in BE Well were informed by literature on the clustering of lifestyle behaviours for health^{204; 205; 206} and wellbeing,²⁵⁶ laypersons' perceptions of wellbeing,¹⁷⁵ and the *Five Ways to Wellbeing* initiative.^{65; 246}

The BE Well audit results were used to identify the behaviours participants were least satisfied with. Participants self-developed four challenges (i.e., one challenge per week) for their partner, and vice versa, to address these high-priority behaviours for change. The weekly challenges utilised a small-changes approach where challenges were based on making small and achievable changes.³⁷³

There is a considerable amount of research to show individuals encounter numerous barriers when attempting to change behaviours.¹⁸⁵ We therefore considered it important to portray that failure could be used as an opportunity for self-reflection and growth. Partners agreed on a self-developed light-hearted penalty to complete if they were unsuccessful at adhering to their challenge for the week. Participants were provided examples of penalties for guidance (e.g., donate to a charity, do something nice for partner, wear something funny to the shops), but were not constrained to these. The penalty was included as a fun element to motivate individuals to adhere to their weekly challenges.

Intervention delivery

The four-week intervention ran from 28 September 2015 to 25 October 2015 for Phase 1 and from 9 November 2015 to 6 December 2015 for Phase 2. The intervention was delivered using a web-based platform (website and email). Evidence shows well designed web-based health

interventions can be effective, cost-effective, and can reach large segments of the population.³⁷⁴ An intervention website included instructions, frequently asked questions, and ethical information (participant information sheet and consent form). All communication between researchers and participants throughout the intervention was via email.

Each Monday during the intervention, the researcher emailed participants a reminder to focus on their new challenge for the week. For Phase 2 only, the email also included a link to a weekly survey where participants were encouraged to reflect and report on how their previous week's challenge went.

Measures

Weekly challenges

For Phase 1, details on participants' challenges were collected at the conclusion of the intervention. For Phase 2, participants submitted their challenges to the research team via the weekly online survey. The survey link was included in the email sent each Monday. Participants who had not submitted their challenges by Wednesday received a reminder email.

Telephone interviews

All those who consented to participate in the feasibility study were invited via email to take part in a post-intervention qualitative telephone interview. Telephone interviews are a versatile method for collecting in-depth qualitative data,³⁷⁵ and offer several advantages over face-to-face data collection including lack of geographical constraints and reduced social pressure.³⁷⁵

All individuals who consented to participate in the intervention (who may or may not have completed the intervention) were invited to take part in an interview.³⁷¹ Interviews were scheduled with participants to take place within two weeks of concluding the intervention. At the beginning of the telephone interview participants were briefed on the purpose and were encouraged to consider the strengths and limitations of the intervention. A semi-structured format with standardised questions was used (Table 20). Where appropriate, probes were used to elicit further discussion and to gain more in-depth insights. In addition, supplementary notes

were taken. A female researcher (KP) with previous qualitative experience led all the telephone interviews.

Table 20. Telephone interview schedule

<ul style="list-style-type: none"> • At the beginning of the game, you were asked to audit your wellbeing and your partner's wellbeing (and vice versa). What did you think of this process? • Were there any areas where your ratings differed? • Over the four-week game, you were asked to complete weekly challenges. Do you have any comments on this process? Were there any challenges you preferred/disliked? Why? • Do you have any comments on the overall structure of the game? What did you like/dislike? What would you improve? • Did you notice any improvements to yours or your partner's health or wellbeing as a result of completing the challenges?
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Data analysis

Challenges

The weekly challenges were re-read several times prior to coding. Directed content analysis was adopted to code the challenge data as it is a recommended method of content analysis when existing theory of a construct exists.³⁷⁶ As such, challenges were coded into pre-determined categories based on positive health behaviours³⁷⁶ which included: nutrition (processed/unprocessed food), alcohol, exercise, sleep, screen-time, sedentary behaviour, slow, connect, give, interest/hobbies, work-life balance, and money/finances.

Telephone interviews

Audio-recordings of telephone interviews were transcribed verbatim (KP). De-identified transcripts were re-read several times in order to become familiar with the data. Transcripts were imported into NVivo (NVivo 10 for Windows; QSR International Pty Limited) for analysis. Using the interview guide as a starting point, qualitative content analysis was used to code the data.²⁶⁴ The codes were reviewed and categorised into sub-themes and themes (KP).

Results

Participant characteristics

Overall, 31 participants were recruited into the study (Figure 12). Of those who consented, 25 participants submitted weekly challenges and 24 participants (completers $n=21$; non-completers $n=4$) agreed to take part in the telephone interview. One participant declined to take part in the interview due to a health issue. The remaining participants did not respond to their email invites; three attempts were made to contact these participants.

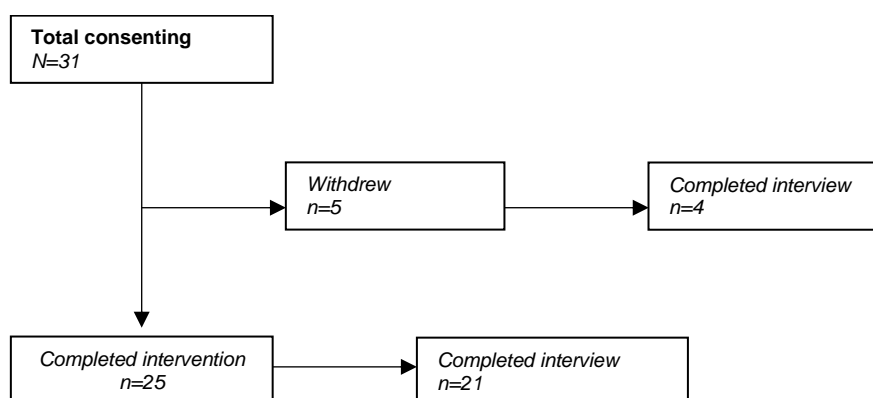


Figure 12. Flow chart of participant recruitment

Characteristics for participants are shown in Table 21. The majority of participants were female. Most participants completed the intervention with their spouse/partner.

Table 21. Participant characteristics

Variable	Characteristics of participants who submitted challenges	Characteristics of participants who completed telephone interview
Total (n)	25	24
Age (mean)	35 years	34 years
Gender		
Female	80%	80%
Male	20%	20%
Ethnicity		
European	84%	84%
Maori	12%	12%
Asian	4%	4%
Partner		
Spouse/partner	57%	60%
Friend	22%	20%
Work colleague	17%	16%
Other	4%	4%

Challenges

In total 89 challenges were submitted by participants (out of a possible 100). With the exception of screen-time, most of the challenges clearly aligned with the pre-determined categories. Challenges based on avoiding screen-time while *in bed* were coded as sleep, *breaking up* screen-time was coded as sedentary behaviour, and all other screen-based challenges were coded as screen-time. Cases which did not represent a pre-determined positive health behaviour were classified as *other* (e.g., to take supplements, to bend at the knees).

Figure 13 shows 59% of the challenges focused on either nutrition (22%), sleep (20%), or exercise (17%). Challenges based on wellbeing behaviours were less popular.

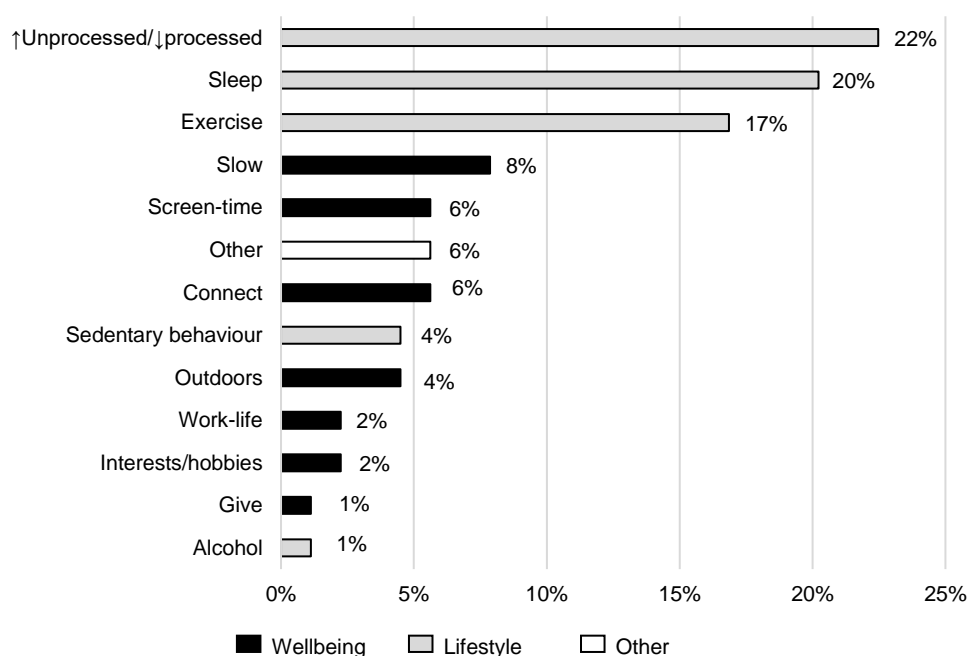


Figure 13. The proportion of challenges representing each positive health behaviour.

Emerging themes

The telephone interviews were approximately 15-minutes. Analysis of the data indicates saturation was achieved. In total five key themes emerged from the data including: audits, social support, delivery, challenges, and penalty (Table 22). Table 22 provides a summary of sub-themes and illustrative quotes (codes).

Audits

Participants liked the simplicity of the audits. Behaviours most frequently mentioned included social connections, work-life balance, hobbies and interests, and sleep. Participants indicated the audits were useful for raising awareness of behaviours they had not spent time considering.

Participants who did have a partner that rated them considered the partner audit process beneficial. However, some participants indicated they needed to know their partner well to complete the partner audit: *"I think the closer you are with your friend, the better they know you. I think it would be more difficult with a friend you didn't know as well"* (Participant [P] 27). Consequently, not everyone completed the partner audit component. One participant indicated the partner audit was the reason she did not complete the intervention stating: *"I would never rate her on those areas. I wouldn't rate anybody"* (P04).

Social support

Most participants enjoyed completing the intervention with a partner; encouragement, motivation, and accountability were among the benefits reported. However, a minority of participants indicated they did not benefit from the social support component, as their partner was not committed to the intervention. Four females indicated they would have preferred to complete the intervention with their spouse/partner, rather than a friend. However, their spouse/partner was not interested:

Participant: *I think it would have been really good if my partner [rather than a friend] and I were doing it together.*

Interviewer: *Would he have completed it with you?*

Participant: *Probably not.*

Delivery

Participants liked the weekly email reminders. Two participants noted, however, that emails "get lost" and suggested text message or Facebook reminders. A common view among participants was that the weekly surveys were quick and easy to complete. Some participants suggested

that the intervention would have benefited from a more interactive component. Views regarding the intervention length were inconsistent. Some enjoyed the four-week intervention, while others thought a longer intervention would be more appropriate for eliciting long-term behaviour change. The majority of participants agreed the intervention took place during a “busy time of year” which affected their normal routines.

Challenges

Participants reported that their challenges were based on behaviours they previously did well or needed “tweaks”. The majority of participants found the process of designing the challenges “enjoyable and straightforward”. However, a minority ($n=3$) said designing the challenges was difficult as it required motivation. About half the participants discussed the relationship between the wellbeing and lifestyle behaviours. A consequence of working late, for example, results in poor meal choices and going to bed later. Conversely, a participant indicated her exercise challenge *“was also a way of spending time with my husband and being in the outdoors. A couple of birds with one stone” (P11)*. The majority of participants discussed positive changes they made; these changes ranged from avoiding technology while in bed, to joining the gym, and regularly cycling to work regularly. Participants indicated the challenges they preferred offered multiple benefits. In addition, their preferred challenges focused on behaviours they were confident in changing and/or wanted to change. In contrast, participants disliked the challenges that focused on behaviours they did not consider a priority, identified barriers beyond their control, or lacked confidence in changing.

Penalty

Very few participants implemented the penalty. Reasons for not implementing the penalty included; the challenges were enough on their own, the idea was silly, and it fell by the wayside. The minority of participants who did implement the penalty described it as motivating: *“It was a good motivator. Even though it was a penalty, we made it fun” (P02)*.

Table 22. Summary of emerging themes, sub-themes, and illustrative quotes

Theme and Sub-themes	Illustrative quote (Participant ID)
Audits	
Increased conscious awareness	I think it was one of those things that you think about but you never really want to admit. I think it brought things out to the forefront and pointed out things you maybe hadn't been too aware of before. (P18)
Partner rating	It was nice to see an outsider's perspective even though he is a close friend it was really good to see if there are any differences between the way others perceive you and the way you see yourself. (P27)
Simplicity	It was easy and it was clear were we needed to get better, or change, or adapt. (P25)
Social support	
Encouragement, motivation, accountability	It was good having someone who was doing it at as well. Someone to see how you were going and to have a chat about it. So, I guess it was encouraging and motivating doing it with someone else. (P12)
Lack of engagement	I was really good and gave my partner her challenge on the Sunday night but she didn't give me my challenges. (P10)
Delivery	
Communication	I think the structure was excellent I really liked the email prompts. (P09)
Interactive	Maybe something more interactive – I'm not sure what exactly that would entail but something that engaged you a bit more or reminded you that each week you're focusing on. (P05)
Length	I think it was a good length. You contacted us every week that was good. I think it was pretty much one month. Some people might want longer to make the changes. (P11)
Weekly surveys	It was good having the surveys at the end of each week. (P03)
Intervention timing	At this time of year, we have lots of functions and things that just make my normal routine a bit more difficult to stick to. (P17)
Penalty	My husband is a bit soft and he didn't actually make me do anything. For the most part, it was me keeping myself honest. (P24)
Challenges	
Reasons for choosing challenges	I looked at what do I not do that I used to be good at doing. Or what am I doing now that I didn't used to do. So things like, what do I actually want to focus on. (P24)
Preferred challenges	I think my favourite was the physical exercise one. Because it's something I know and I actually enjoyed it. I got more out of it. The other ones I should do and need to do but with exercise, there were extra benefits. (P15)
	The challenges that I found easiest to complete were the ones that I really wanted to change anyway. (P12)
Positive changes	One of my challenges was to have no screen time in bed and I did notice a definite improvement in sleep quality. So I will keep that up. (P10)
Concomitant behaviours	So if I get off my phone and get home early enough then I will be able to cook myself a decent dinner and those kind of things. (P18)
	You would think getting up at 5am each day [to exercise] you would be tired but I actually have more energy than I've ever had. (P25)
Unsuccessful challenges	The [meeting socially with] work colleague one I completely failed on and the food diary one – because I hate doing that sort of thing. I almost gave up before I started. (P12)

Discussion

Integrating initiatives from positive psychology into public health messages to promote “complete physical, mental and social well-being beyond the mere absence of disease”¹ may provide a suitable alternative to current deficit models.³⁶¹ In an attempt to reorient toward a framework for positive health, we evaluated the acceptability and feasibility of an initiative integrating wellbeing and lifestyle behaviours. Interviews with participants show strengths of the intervention included the promotion of multiple wellbeing and lifestyle behaviours, the BE Well audit tool, self-tailored challenges, weekly surveys, and weekly reminder emails. Conversely limitations of *N=ONE* included the timing of the intervention, penalty, and the limited interactive content. Inconsistent findings were reported for the social support component and the length of the intervention.

Participants’ reflections on the relationship between multiple wellbeing and lifestyle behaviours was an important finding to emerge. Interestingly, the majority of tailored challenges concentrated on modifying nutrition, exercise, and sleep. This finding corroborates previous research which shows laypersons consider lifestyle behaviours important for their wellbeing.³⁶⁶ There is also emerging evidence to show lifestyle behaviours are associated with optimal wellbeing.^{235; 256} Together, there is increasing evidence to support the promotion of lifestyle behaviours for optimal wellbeing. However, positive psychology interventions designed to promote wellbeing currently focus on gratitude exercises, mindfulness, positive writing, positive statements, strengths exercises, and hope therapy.^{21; 23; 25} Whilst these positive psychology interventions yield improvements in wellbeing,^{21; 25} their acceptability to the general public has been questioned.²³ Although preliminary, our findings suggest having a greater emphasis on lifestyle behaviours, rather than wellbeing, may be more acceptable to the public in positive health interventions. Such messages might promote exercising with friends, spending time outdoors, or eating a healthy breakfast with family.

In this study, accountability, motivation, and encouragement were among the cited benefits of completing the intervention with a partner. This is consistent with previous qualitative research where participants identified accountability as a factor which influences behaviour change.³⁷⁷ Evidence in the literature also shows social presence is important for providing accountability

and for improving adherence to behaviour change.^{357; 378} However in spite of the recognised benefits of social support, the concerns expressed by the minority of participants and non-participants are pertinent to consider. For example, some participants highlighted a lack of partner engagement and difficulty finding a partner. Previous research shows enlisting non-participating support persons³⁷⁹ or incorporating social media components into interventions^{380; 381} provide other options for enhancing social support and accountability. Findings from a recent report indicate that 49% of New Zealanders use social media to stay in touch with supportive friends.³⁸² Thus, incorporating a social media aspect into further iterations of the *N=ONE* intervention might be beneficial. A social media aspect may also make the intervention more acceptable to those wanting an interactive component.

There is consensus that motivating individuals to successfully adopt positive behaviours is challenging.²⁵⁸ Thus, in an attempt to encourage individuals to adopt positive health behaviours we used tailored challenges and a non-prescriptive approach in the current study. The majority of participants indicated they enjoyed working with their partner to design challenges to meet their needs. Previous research indicates that tailored interventions are likely to be more engaging, than generic public health messages and interventions.³⁶⁷ Furthermore, providing individuals with choice and encouraging them to actively participate in identifying high priority behaviours for change have been identified as useful behaviour change strategies.¹⁷⁴ Further research needs to determine whether the combination of tailored challenges and a non-prescriptive approaches result in long-term behaviour change in the right areas.

Although recognition of the explicit need to promote positive health is increasing,^{3; 14} the translation and promotion of initiatives integrating wellbeing and lifestyle behaviours are limited. In this study, participant-designed challenges mainly concentrated on lifestyle behaviours; however, participants indicated the audit process increased their awareness of connecting and work-life balance, as well as hobbies and interests. Further iterations of the current intervention should consider alternative options for encouraging social support; incorporating a more interactive component; identifying effective ways to implement the penalty; and timing of intervention delivery. Further research is also needed to understand whether *N=ONE*, or similar initiatives integrating positive psychology and public health principles, can be used to effectively and sustainably improve health and wellbeing outcomes.

In spite of the contributions the study makes to the positive health literature, there are limitations to consider. Firstly, it was beyond the scope of this study to measure changes in health and/or wellbeing. Secondly, the response rate was low and comprised mainly female participants. The response rate may have been influenced by the requirement for enlisting a partner. In addition, ethical approval for the study required participants to sign, scan, and email consent forms to the research team, limiting the sample to those with access to a printer and/or scanner. Whilst the findings from this study provide valuable insights into the feasibility and acceptability of the intervention, caution in generalizing the findings is advised. Further research in larger and more diverse samples is required to determine whether *N=ONE*, or similar initiatives, are effective for improving positive health.

Chapter 9

General discussion

Summary

A disconnect between positive health policy and deficit-based practice provided the starting point for this doctoral thesis. Positive psychology and public health were identified as two disciplines that could contribute toward addressing this gap and reorienting the health system toward promoting positive health. Positive psychology not only provides robust articulations of optimal wellbeing,^{17; 18; 19; 62} but has also begun to translate wellbeing into practice.^{21; 22; 23; 24; 25} However, in doing so positive psychology has neglected to consider the role lifestyle behaviours might play in maintaining or optimising wellbeing. Lifestyle behaviours are not only central for day-to-day living, but they also underpin optimal health.^{27; 28; 29; 30} Public health on the other hand, recognises the need to promote lifestyle behaviours at the population level, but in reality the focus has been on disease prevention.

To address the disconnect between positive health policy and deficit-based practice and to reorient toward a framework for positive health, a better integration of disciplines was needed. Accordingly, this thesis integrates positive psychology and public health. The overarching aim of the doctoral research was to explore an approach for reorienting toward a framework for positive health. Biological plausibility, epidemiological research, and translational research were used to guide the direction of this exploratory thesis.

Research contributions and implications

As a whole, the findings from this doctoral research make a unique and substantial contribution to the body of knowledge. Wider contributions of this doctoral work include:

- Refining a framework for positive health through the integration of biological plausibility, positive psychology, and public health.

- The convergence of biological (Chapter 2), epidemiological (Chapter 4), and translational (Chapters 5-8) research to endorse promoting multiple lifestyle behaviours concurrently in a positive health framework.
- Integrating wellbeing and lifestyle behaviours to translate positive health into practice.

Specific contributions that the research makes to the literature are presented below.

Biological plausibility

i. Hormetic model of wellbeing

An initial step in determining whether lifestyle behaviours might be useful for promoting optimal wellbeing, was to investigate the biological plausibility. Whilst there was evidence in the literature to suggest the link between lifestyle behaviours and optimal wellbeing was biologically plausible,⁶³ the literature was haphazard. Chapter 2 therefore draws together, and extends, current literature to explore the relationship between lifestyle behaviours and optimal wellbeing using a hormetic model. Bringing together multiple lifestyle behaviours, the hormetic model shows the link between lifestyle behaviours and optimal wellbeing is biologically plausible.

Wellbeing epidemiology

After reviewing existing evidence (Chapter 2), it was evident that epidemiological research investigating the lifestyle behaviours associated with optimal wellbeing was limited in New Zealand and internationally. In combining the assessment of multiple lifestyle behaviours and optimal wellbeing for the first time in a large population study, the findings from Chapters 3 and 4 make a significant contribution toward national and international wellbeing epidemiology.

ii. Associations between lifestyle behaviours and optimal wellbeing

In Chapter 3 the relationship between 10 lifestyle behaviours and optimal wellbeing were examined in a large and diverse sample of New Zealand adults ($n=9,514$). The findings corroborate previous research^{160; 161} to show exercising more regularly was associated with an increased likelihood of achieving the criteria for optimal wellbeing.^{163; 164} In addition, novel

findings to emerge were the independent associations between sitting, sleep, and sugary drink consumption and optimal wellbeing. These findings extend previous international research on life satisfaction⁵⁰ and happiness⁵¹ to show associations between lifestyle behaviours and a multi-dimensional measure of optimal wellbeing. Although causality could not be determined, the findings from Chapter 3 highlight potential behaviours to investigate in intervention studies targeting optimal wellbeing and positive health.

iii. Multiple lifestyle behaviours and optimal wellbeing

Extending the research of Chapter 3, the relationship between endorsing multiple healthy lifestyle behaviours and optimal wellbeing is explored in Chapter 4 ($n=9,425$). The findings show that in comparison to endorsing ≤ 1 healthy lifestyle behaviour, endorsing 4-5 healthy lifestyle behaviours is associated with a 4.7-fold increase in the likelihood of achieving the criteria for optimal wellbeing. In a previous study, Evers et al.⁵² show that those endorsing fewer health risk behaviours were more likely to be satisfied with their lives. However, Chapter 4 demonstrates for the first time that endorsing multiple healthy lifestyle behaviours is associated with synergistic increases in optimal wellbeing. Of concern, therefore, was the evidence to show just 5% of the sample engaged in all five of the healthy lifestyle behaviours examined. This finding, albeit with different behaviours, is in line with previous research that has also reported low prevalence rates for meeting multiple healthy lifestyle behaviours.^{205; 241; 243} Again, whilst these findings are cross-sectional, they suggest increasing the number of healthy lifestyle behaviours endorsed is likely beneficial for optimal wellbeing.

iv. Clustering of lifestyle behaviours

There is some debate in the literature regarding whether public health interventions should target isolated or multiple lifestyle behaviours.^{31; 32; 33} To identify whether isolated lifestyle behaviours or multiple behaviours should be targeted in a positive health initiative, the clustering of lifestyle behaviours were explored (Chapter 4). Previous international research has mostly focused on the clustering of physical inactivity, poor diets, smoking, and alcohol.²⁰⁵ Similarly, the two previous clustering studies conducted in New Zealand focused on fruit and vegetables,^{240;} ²⁴¹ physical inactivity,^{240; 241} smoking,²⁴⁰ alcohol,²⁴⁰ and BMI.²⁴¹ Extending this research, Chapter

4 investigates the clustering of the novel healthy and unhealthy behaviour combinations of sleep, physical activity, sedentary behaviour, sugary drink intake, and fruit and vegetable intake. The findings of Chapter 4 show clustering for both five healthy (O/E 2.0, 95% CI 1.8-2.2) and unhealthy (O/E 2.1, 95% CI 1.9-2.3) behaviours. Although the findings are inconsistent with New Zealand research,^{240; 241} they corroborate previous international research exploring the clustering of health risk behaviours.^{204; 205; 206} The evidence to support the clustering of lifestyle behaviours indicates it may be beneficial to target multiple lifestyle behaviours, concurrently, in a positive health initiative.

Translation of positive health

A bidirectional relationship between lifestyle behaviours and optimal wellbeing cannot be discounted. However, together the epidemiological evidence and the research to support the biological plausibility, provides the rationale for including lifestyle behaviours in a positive health intervention. At the outset of this thesis, there was limited research integrating wellbeing and lifestyle behaviours to translate positive health into practice. The final series (Chapters 5-8) of studies therefore sought to address this gap; firstly, through a series of formative work, and secondly, through implementation.

Formative research

Formative research allows the development of messages tailored to a target audience preference and can improve the feasibility, effectiveness, and likelihood of sustainability of the messages.^{34; 35} Thus, to understand how laypersons would prefer to see lifestyle behaviours promoted and translated into a positive health intervention, formative research was used.

v. Qualitative evaluation of nutrition, physical activity, and sleep guidelines

Whilst international research has explored laypersons' perceptions of nutrition,^{279; 280; 383} perceptions of physical activity guidelines are limited.²⁸¹ Further, to the best of knowledge no published data on laypersons' perceptions of nutrition, physical activity, or sleep guidelines exists in New Zealand. The findings from Chapter 5, while preliminary, raise some intriguing questions in regards to current guidelines and the promotion of guidelines. Despite expert

consensus that 30-minutes of physical activity on most days is “a realistic behavioural target for the general population” (p. 84),¹⁸⁴ participants were not receptive to the guideline. Nor were participants receptive the prescriptive sleep guideline. Though comparative studies are limited, nutrition research shows prescriptive messages may promote a sense of failure.²⁷⁴ Removing quantifiable periods from physical activity messaging warrants further investigation in more diverse samples.

A novel contribution of Chapter 5 was exploring perceptions of nutrition, physical activity, and sleep guidelines in the same sample. Accordingly, discussion on the concomitant relationship between lifestyle behaviours emerged. Study participants were in favour of promoting nutrition, physical activity, and sleep alongside each other. Since collecting the data for Chapter 5, updated Eating and Activity Guidelines have been released²⁴⁷ and moving in the right direction now combine nutrition and physical activity. However, references to the positive benefits of engaging in healthy lifestyle behaviours are omitted. Instead, the focus is on maintaining a healthy weight to prevent type 2 diabetes, heart disease, and cancers.²⁴⁷ Nevertheless, the findings from Chapter 5 indicate emphasising benefits beyond weight loss may be relevant for encouraging those not at ‘health risk’ to maintain or adopt healthier lifestyles.

vi. Exploring lifestyle behaviour change messages in popular books and podcasts

Of concern, was participants’ uncertainty of where to find the guidelines and credible health information (Chapter 5). This may reflect the change in New Zealand’s government from the political left to the political right and the subsequent demise of many public health initiatives. Concurrently, there has been a prolific increase in the availability of self-help lifestyle information to the public via digital sources such as Amazon and iTunes. In light of the popularity of these sources, an innovative formative review was conducted (Chapter 6) to identify potential strategies to incorporate into a positive health intervention. This research was the first to systematically assess nutrition, exercise, sleep, and wellbeing messages in popular books and podcasts. A pertinent finding to emerge from the review was that the majority of titles promoted lifestyle behaviours concurrently, with just seven titles promoting stand-alone behaviours. This contrasts most public health initiatives that target lifestyle behaviours in isolation.^{251; 273} It was also of interest to observe that 33% of books and 26% of podcasts

promoted the combination of nutrition, exercise, sleep, and wellbeing. Despite this popular trend, initiatives integrating multiple lifestyle and wellbeing behaviours in public health settings are limited.

Implementation

The findings from Chapters 2-6 converge to show targeting multiple lifestyle behaviours within a positive health intervention is supported by epidemiological evidence; is biologically plausible; and is likely to appeal laypersons. The final section of the doctoral work focuses on integrating multiple lifestyle behaviours and wellbeing to implement a positive health intervention.

vii. Development of the BE Well audit tool

For positive health interventions to meet the needs of individuals and population groups, the ability to prioritise the most appropriate wellbeing or lifestyle behaviours in an intervention or clinical setting would be beneficial. Whilst instruments are available to assess satisfaction across wellbeing domains,³⁶⁴ none assessing satisfaction across multiple wellbeing and lifestyle behaviours concurrently was available. Consequently, the BE Well tool was developed (Chapter 7). The subjective nature of BE Well is an advantage, as respondents can weight behaviours in any way they choose. BE Well, therefore, allows the most salient positive health behaviours to be identified. Testing the utility of the tool in an intervention setting ($n=27$) shows the majority of participants were least satisfied with their consumption of sugar and processed food (89%), screen-time (85%), time outdoors (85%), and exercise (81%). Nevertheless, limited reliability for three items shows further development of the tool is required before further research exploring the application of BE Well in more diverse samples is undertaken.

viii. Implementation of a positive health intervention

In the final study (Chapter 8), an innovative positive health intervention was developed based on the convergence of findings from the previous studies comprising the doctoral thesis. The intervention was non-prescriptive (Chapter 5); comprised multiple lifestyle (Chapters 2-6) and wellbeing (Chapters 6-7) behaviours; was flexible and adaptable to the needs of individuals' (Chapters 2 and 5); and utilised the BE Well tool (Chapter 7).

The findings from Chapter 8 show the majority (59%) of weekly challenges focused on nutrition, sleep, and exercise. Although the sample was small, the findings corroborate previous research that shows laypersons consider lifestyle behaviours important for their wellbeing.¹⁷⁵ Preference for changing lifestyle behaviours may partly be explained by less awareness of the benefits of endorsing wellbeing actions.

It was of interest to find that while participants indicated in the BE Well study (Chapter 7) that they wanted to spend more time outdoors and less-time on screens, the top challenges in the feasibility study did not focus on these areas. This might be because the challenges designed by participants were not necessarily mutually exclusive. For example, people may have chosen to exercise more in the outdoors or reduce screen-time prior to bed to improve sleep quality.

The preliminary findings from feasibility study (Chapter 8) suggest having a greater emphasis on lifestyle behaviours, rather than wellbeing, may be more acceptable to the public in positive health interventions. Further research exploring the acceptability of using lifestyle behaviours as a gateway to promoting wellbeing would be interesting.

Interviews with participants show strengths of the positive health intervention included the promotion of multiple wellbeing and lifestyle behaviours, the BE Well audit tool, self-tailored challenges, weekly surveys, and weekly reminder emails. Conversely limitations of *N=ONE* included the timing of the intervention, penalty, and the limited interactive content. Inconsistent findings were reported for the social support component and the length of the intervention. Whilst these findings indicate *N=ONE* is likely to be acceptable with modifications, effectiveness trials are needed to ascertain whether the intervention is beneficial for improving health and optimal wellbeing.

Positive health in the wider context

Recognising limitations with the current deficit-based health system, the New Zealand Ministry of Health has urged the Health Minister to lead the shift toward a wellness focus.⁸ Although the exploratory nature of this thesis limits the generalizability of the findings, it is hoped the findings act as a platform for initiating timely discussion about positive health. Mapping New Zealand's public health initiatives shows very little is currently being done to promote "health and wellbeing

for all New Zealanders” (p. 7)² (Table 23). With 24% of the population meeting the criteria for optimal wellbeing and just 5% of the population endorsing the five healthy lifestyle behaviours assessed in Chapter 4, it is evident more can be done.

Table 23. Mapping public health programmes in New Zealand

	Public health programmes and initiatives
Rehabilitation/Intervention to treat disease	Green prescription Alcohol (helplines) Mental health (Depression, suicide, helplines) Smoking
Screening for disease	Screening (cancer) Oral health Rheumatic fever
Prevention of disease	Immunisations Alcohol (No Beersies) Nutrition (Breakfast-eaters, Food star rating, Healthy Beverages) Breakfast-eaters Childhood obesity plan Gambling Smoking (packaging, smoke free NZ) Healthy families Oral health Supplementation (iodine, fluoride) Youth Mental Health Project
Promoting health and wellbeing	Five Ways to Wellbeing Wellbeing game Mindfulness (pause, breathe, smile) Breastfeeding (bonding)

The tyranny of the urgent approach that is the reality of the health system, neglects to consider those who are not at health risk, or sick, or injured. Yet, the health sector traditionally serves as a gatekeeper of health information²⁷⁵ Consequently, the reach of health messages is limited to those who are already ‘sick’. Although Chapter 5 comprised a small sample, limited reach of health messages likely reflected participants’ uncertainty of where to locate guidelines or find credible health information. A shift toward narrowing this gap and promoting positive health through initiatives such as *N=ONE* to the general population may go some way. However, considerably more action and funding is needed to develop sustainable solutions.

Substantial re-allocation of funding would be required to address the disconnect between positive health policy and deficit-based practice. Previously I have highlighted that the Health Promotion Agency receives just \$25-\$33 million of New Zealand’s \$15.6 billion healthcare budget,⁵ which equates to just 0.01 percent. However, most of this funding is spent on alcohol, gambling, and smoking. Increasing funding for positive health to 0.1 percent of the health

budget would go some way toward narrowing the gap between positive health policy and deficit-based practice. However, New Zealand Treasury stipulates that health spending needs be directed toward obtaining maximal output.⁴⁰ Treasury highlights that there is currently insufficient evidence to show the long-term costs of population-level health promotion are less expensive than the subsequent costs of treatment.⁴⁰ Arguably, limiting health spending decisions to obtaining maximum financial return-on-investment is the type of approach partly responsible for driving the deficit-based health system. This type of approach neglects to consider the ethical and moral imperative of promoting health and optimal wellbeing. At an individual-level, day-to-day spending decisions are made in relation to wellbeing, rather than return-on-investment. However, at the population-level return-on-investment is the predominant driver.

Nevertheless, re-allocation of funding toward positive health is unlikely to occur without evidence-based research to show not only the individual benefits, but also importantly, the cost-effectiveness and economic benefits of adopting a positive health approach. Even with evidence-based research, increasing funding for positive health will have opportunity costs. Limited fiscal capacity suggests funding for positive health will result in a deficit elsewhere. Thus, public opinion plays an influential role in the allocation of funding. Without evidence-based research or supportive public opinion, reorienting toward positive health is unlikely to overcome perhaps one of the greatest challenges—political survivability. It is hoped the findings from this doctoral research are built on to develop the evidence and to initiate conversations on positive health.

Study limitations

In addition to the delimitations outlined in Chapter 1, the thesis is subject to the following limitations:

1. Data for Chapters 3 and 4 were collected using a web-based survey design. Web-based surveys offer a number of advantages, however, the response rate was low (32%). Comparisons to the estimated resident population in New Zealand during the September

2012 quarter indicate our sample was slightly over-represented by younger adults and slightly under-represented by those aged over 60 years.

2. Data for Chapters 3 and 4 are cross-sectional, precluding the ability to infer causality. It is likely the relationship between lifestyle behaviours and optimal wellbeing is bidirectional. Nevertheless, the hormetic model of wellbeing (Chapter 2) provides evidence to indicate biologically plausible pathways linking lifestyle behaviours and optimal wellbeing.
3. Data for Chapters 5, 7, and 8 relied on convenience samples and the sample sizes were small. While this limits the generalizability of the findings, the sample sizes reflect the feasibility and formative work.
4. In the review of books and podcasts, it was beyond the scope of the study to analyse the scientific evidence underpinning the philosophies promoted.
5. Reliability of three-items of the BE WELL were weak to moderate (unprocessed food, $r = 0.47$; medium; processed food, $r = 0.35$, medium; and exercise, $r = 0.23$, weak). Further iterations of the wording and comprehension of these items are required. Thus, caution is recommended in making inferences from these items.

Future research

The exploratory research comprising the doctoral thesis provides a much-needed initial step in refining a framework for positive health and understanding the application of lifestyle behaviours within this framework. Nevertheless, it is unlikely that the necessary public, political, and fiscal support will be gained without further evidence-based research to support the benefits and cost-effectiveness of promoting positive health. Considerably more research is required to reorient the deficit-based health system toward promoting positive health.

As a starting point, it would be an advantage to include an instrument, such as Huppert and So's¹⁸ scale, in the New Zealand Health Survey and the General Social Survey. This is necessary for developing a more comprehensive understanding and longer-term monitoring of

positive health in New Zealand. In addition, monitoring optimal wellbeing at the national-level is useful for evaluating the impact of public health initiatives.

More broadly, wellbeing epidemiological research needs to explore other factors associated with optimal wellbeing both in New Zealand, and internationally. Rather than concentrating on minimum 'doses' for disease prevention, exploring and understanding doses for positive health warrants consideration. Further epidemiological research should be undertaken to explore associations across the disease-optimal wellbeing spectrum. It would also be an advantage if such research employed objective measures where possible, such as accelerometers to assess physical activity.

Supportive public opinion is likely to be influential in reorienting toward positive health. Thus, developing insights into what the public want is important. Further refining and implementing the BE Well tool in different settings would be valuable for developing such insights into the wellbeing factors that should be prioritised for change.

Finally, further intervention research focusing on the integration of wellbeing and lifestyle behaviours to promote positive health is needed. While the *N=ONE* intervention makes a valuable contribution to the literature, no objective health or wellbeing data were collected. Accordingly, the logical step to progress this work is to implement an effectiveness trial of the intervention. Effectiveness trials of *N=ONE* and other positive health initiatives should aim to evaluate components such as those outlined in the RE-AIM framework including reach, effectiveness, acceptability, implementation, and maintenance.³⁸⁴ Developing the evidence on the cost-effectiveness and longer-term impacts of positive health interventions is important.

Continuing to reorient toward a framework for positive health will not be without challenges. However, this doctoral research has made a significant contribution toward addressing the gap between positive health policy and deficit-based practice.

References

1. World Health Organization. (1946). Constitution of the World Health Organization. *American Journal of Public Health and the Nations Health*, 36(11), 1315-1323.
2. Ministry of Health. (2000). *New Zealand health strategy*. Wellington: Ministry of Health.
3. Ryff, C. D., & Singer, B. (1998). The contours of positive human health. *Psychological Inquiry*, 9(1), 1-28. doi:10.1207/s15327965pli0901_1
4. Ministry of Health. (2016, 22 February 2016). *Health targets*. Retrieved 03 March, 2016, from www.health.govt.nz/new-zealand-health-system/health-targets
5. Health Promotion Agency. (N.D.). *Health Promotion Agency*. Retrieved 17 February, 2016, from <http://www.hpa.org.nz>
6. Ministry of Health. (2015). Annual report for the year ended 30 June 2015. Retrieved from <http://www.health.govt.nz/system/files/documents/publications/annual-report-year-ended-30-june-2015-ministry-of-health-oct15.pdf>
7. Guðmundsdóttir, D. (2011). Positive psychology and public health. In R. Biswas-Diener (Ed.), *Positive Psychology as Social Change* (10.1007/978-90-481-9938-9_7). Netherlands: Springer. doi:10.1007/978-90-481-9938-9_7
8. Ministry of Health. (2014). *Briefing to the incoming minister* Retrieved from www.health.govt.nz/system/files/documents/publications/briefing-to-incoming-minister-of-health-nov14-v2.pdf
9. Ministry of Health. (2015). *Health and independence report: 2015*. Wellington: Ministry of Health.
10. Ministry of Health. (2013). *Health loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016*. Wellington: Ministry of Health.
11. Beaglehole, R., Ebrahim, S., Reddy, S., Voute, J., & Leeder, S. (2007). Prevention of chronic diseases: A call to action. *Lancet*, 370, 2152–2157. doi:10.1016/S0140-6736(07)61700-0
12. Ministry of Health. (2015). Annual update of key results 2014/15: New Zealand health survey. Retrieved from www.health.govt.nz/publication/annual-update-key-results-2014-15-new-zealand-health-survey
13. Kobau, R., Seligman, M., Peterson, C., Diener, E., Zack, M. M., Chapman, D., & Thompson, W. (2011). Mental health promotion in public health: Perspectives and strategies from positive psychology. *American Journal of Public Health*, 101(8), e1-e9. doi:10.2105/AJPH.2010.300083
14. Seligman, M. (2008). Positive health. *Applied Psychology*, 57(S1), 3-18. doi:10.1111/j.1464-0597.2008.00351.x
15. Park, N., Peterson, C., Szvarca, D., Vander Molen, R. J., Kim, E. S., & Collon, K. (2014). Positive psychology and physical health: Research and applications. *American Journal of Lifestyle Medicine*, 10.1177/1559827614550277. doi:10.1177/1559827614550277
16. Seligman, M., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist*, 55(1), 5-14. doi:10.1037//0003-066X.55.1.5

17. Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D.-w., Oishi, S., & Biswas-Diener, R. (2010). New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research*, 97(2), 143-156. doi:10.1007/s11205-009-9493-y
18. Huppert, F. A., & So, T. T. C. (2013). Flourishing across Europe: Application of a new conceptual framework for defining well-being. *Social Indicators Research*, 110(3), 837-861. doi:10.1007/s11205-011-9966-7
19. Keyes, C. L. M. (2002). The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior*, 43(2), 207-222. doi:10.2307/3090197
20. Seligman, M. (2012). *Flourish: A visionary new understanding of happiness and well-being* [Kindle]
21. Bolier, L., Haverman, M., Westerhof, G. J., Riper, H., Smit, F., & Bohlmeijer, E. (2013). Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health*, 13(1). doi:10.1186/1471-2458-13-119
22. Cohn, M., & Frerickson, B. (2010). In search of durable positive psychology interventions: Predictors and consequences of long-term positive behaviour change. *The Journal of Positive Psychology*, 5(5), 355-366.
23. Hone, L. C., Jarden, A., & Schofield, G. M. (2014). An evaluation of positive psychology intervention effectiveness trials using the re-aim framework: A practice-friendly review. *The Journal of Positive Psychology*, 10(4), 303-322. doi:10.1080/17439760.2014.965267
24. Seligman, M. E. P., Steen, T. A., Park, N., & Peterson, C. (2005). Positive psychology progress: Empirical validation of interventions. *American Psychologist*, 60(5), 410-421. doi:10.1037/0003-066X.60.5.410
25. Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of Clinical Psychology*, 65(5), 467-487. doi:10.1002/jclp.20593
26. Hefferon, K., & Mutrie, N. (2012). Physical activity as a "stellar" positive psychology intervention. In E. O. Acevedo (Ed.), *The Oxford handbook of exercise psychology*. Oxford: Oxford University Press.
27. Willett, W. C., & Stampfer, M. J. (2013). Current evidence on healthy eating. *Annual Review of Public Health*, 34, 77-95. doi:10.1146/annurev-publhealth-031811-124646
28. Bauman, A. E. (2004). Updating the evidence that physical activity is good for health: An epidemiological review 2000–2003. *Journal of Science and Medicine in Sport*, 7(1, S1), 6-19. doi:10.1016/S1440-2440(04)80273-1
29. Alvarez, G. G., & Ayas, N. T. (2004). The impact of daily sleep duration on health: A review of the literature. *Progress in Cardiovascular Nursing*, 19(2), 56-59.
30. Chaput, J.-P., & Tremblay, A. (2012). Insufficient sleep as a contributor to weight gain: An update. *Current Obesity Reports*, 1(4), 245-256. doi:10.1007/s13679-012-0026-7
31. Evers, K. E., & Quintiliani, L. M. (2013). Advances in multiple health behavior change research. *Translational Behavioral Medicine*, 3(1), 59-61. doi:10.1007/s13142-013-0198-z
32. Prochaska, J. J., & Prochaska, J. O. (2011). A review of multiple health behavior change interventions for primary prevention. *American Journal of Lifestyle Medicine*, 5(3), 208-221. doi:10.1177/1559827610391883

33. Prochaska, J. J., Spring, B., & Nigg, C. R. (2008). Multiple health behavior change research: An introduction and overview. *Preventive Medicine*, 46(3), 181-188. doi:10.1016/j.ypmed.2008.02.001
34. Zapka, J., Lemon, S. C., Estabrook, B. B., & Jolicoeur, D. G. (2007). Keeping a Step Ahead: Formative Phase of a Workplace Intervention Trial to Prevent Obesity. *Obesity*, 15(S1), 27S-36S. doi:10.1038/oby.2007.385
35. Vastine, A., Gittelsohn, J., Ethelbah, B., Anliker, J., & Caballero, B. (2005). Formative research and stakeholder participation in intervention development. *American Journal of Health Behavior*, 29(1), 57-69.
36. Breslow, L. (1972). A quantitative approach to the World Health Organization definition of health: Physical, mental and social well-being. *International Journal of Epidemiology*, 1(4), 347-355. doi:10.1093/ije/1.4.347
37. Seeman, J. (1989). Toward a model of positive health. *American Psychologist*, 44(8), 1099-1109.
38. Brussow, H. (2013). What is health? *Microbial Biotechnology* 6(4), 341-348. doi:10.1111/1751-7915.12063
39. Roy, M., Levasseur, M., Couturier, Y., Lindström, B., & Gagnéux, M. (2015). The relevance of positive approaches to health for patient-centered care medicine. *Preventive Medicine Reports*, 2, 10-12. doi:10.1016/j.pmedr.2014.11.005
40. New Zealand Treasury. (2013). Health projections and policy options. *Background paper for the 2013 statement on the long-term fiscal position*. Retrieved from www.treasury.govt.nz/government/longterm/fiscalposition/2013
41. New Zealand Treasury. (2015, 23 March 2016). *Health*. Retrieved 2016, 23 March, from <http://www.treasury.govt.nz/government/expenditure/health>
42. Ministry of Health. (2013). Targeting prevention. Retrieved from www.health.govt.nz/system/files/documents/publications/targeting-prevention-2013-nov13-v2.pdf
43. Keyes, C. L. (1998). Social Well-Being. *Social Psychology Quarterly*, 61(2), 121-140.
44. Helliwell, J. F., & Putnam, R. D. (2004). The social context of well-being. *Philosophical transactions of the Royal Society of London*, 359(1449), 1435-1446. doi:10.1098/rstb.2004.1522
45. Diedericks, E., & Rothmann, S. (2014). Flourishing of information technology professionals: Effects on individual and organisational outcomes *South African Journal of Business Management*, 45(1), 27-41.
46. Blanchflower, D., & Oswald, A. J. (2011). International happiness: A new view on the measure of performance. *Academy of Management Perspectives*, 6-22.
47. Boehm, J. K., & Kubzansky, L. D. (2012). The heart's content: the association between positive psychological well-being and cardiovascular health. *Psychological Bulletin*, 138(4), 655-691. doi:10.1037/a0027448
48. Huppert, F. A. (2009). Psychological well-being: Evidence regarding its causes and consequences. *Applied Psychology: Health and Well-Being*, 1(2), 137-164. doi:10.1111/j.1758-0854.2009.01008.x
49. Boles, M., Pelletier, B., & Lynch, W. (2004). The relationship between health risks and work productivity. *Journal of Occupational and Environmental Medicine*, 46(7), 737-745. doi:10.1097/01.jom.0000131830.45744.97

50. Grant, N., Wardle, J., & Steptoe, A. (2009). The relationship between life satisfaction and health behavior: A cross-cultural analysis of young adults. *International Journal of Behavioral Medicine*, 16(3), 259-268. doi:10.1007/s12529-009-9032-x
51. Piqueras, J. A., Kuhne, W., Vera-Villarreal, P., Van Straten, A., & Cuijpers, P. (2011). Happiness and health behaviours in Chilean college students: A cross-sectional survey. *BMC Public Health*, 11(443), 10.1186/1471-2458-1111-1443. doi:10.1186/1471-2458-11-443
52. Evers, K. E., Castle, P. H., Prochaska, J. O., & Prochaska, J. M. (2014). Examining relationships between multiple health risk behaviors, well-being, and productivity. *Psychological Reports*, 114(3), 843-853. doi:10.2466/13.01.PR0.114k25w4
53. Khaw, K.-T., Wareham, N., Bingham, S., Welch, A., Luben, R., & Day, N. (2008). Combined impact of health behaviours and mortality in men and women: The EPIC-Norfolk prospective population study. *PLoS Medicine*, 5(1). doi:10.1371/journal.pmed.0050012
54. American Diabetes Association. (2013). Economic costs of diabetes in the U.S. in 2012. *Diabetes Care*, 36(4), 1033-1046. doi:10.2337/dc12-2625
55. Pratt, M., Macera, C. A., & Wang, G. (2000). Higher direct medical costs associated with physical inactivity. *The Physician and Sportsmedicine*, 28(10), 63-70. doi:10.3810/psm.2000.10.1237
56. World Health Organization. (1986). Ottawa charter for health promotion. *Health Promotion International*, 1(4), 405-405.
57. Mezzich, J. E. (2005). Positive health: Conceptual place, dimensions and implications. *Psychopathology*, 38(4), 177-179. doi:10.1159/000086086
58. Ickovics, J. R., & Park, C. L. (1998). Paradigm shift: Why a focus on health is important. *Journal of Social Issues*, 54(2), 237-244.
59. Vazquez, C., Hervas, G., Rahona, J., & Gomez, D. (2009). Psychological well-being and health: Contributions of positive psychology. *Annuary of Clinical and Health Psychology*, 5, 15-27.
60. Aspinwall, L. G., & Tedeschi, R. G. (2010). The value of positive psychology for health psychology: Progress and pitfalls in examining the relation of positive phenomena to health. *Annals of Behavioral Medicine*, 39(1), 4-15. doi:10.1007/s12160-009-9153-0
61. Park, J. H. (2015). Health care design: Current and potential research and development. *Design Issues*, 31(1), 63-72. doi:10.1162/DESI_a_00310
62. Hone, L., Jarden, A., & Schofield, G. (2014). Measuring flourishing: the impact of operational definitions on the prevalence of high levels of wellbeing. *International Journal of Wellbeing*, 4(1), 62-90. doi:10.5502/ijw.v4i1.4
63. Gomez-Pinilla, F. (2008). The influences of diet and exercise on mental health through hormesis. *Ageing Research Reviews*, 7(1), 49-62. doi:10.1016/j.arr.2007.04.003
64. Huppert, F. A., Marks, N., Clark, A., Siegrist, J., Stutzer, A., Vitterso, J., & Wahrendorf, M. (2009). Measuring well-being across Europe: Description of the ESS well-being module and preliminary findings. *Social Indicators Research*, 91(3), 301-315. doi:10.1007/s11205-008-9346-0
65. Aked, J., Marks, N., Cordon, C., & Thompson, S. (2011). Five ways to well-being evidence: A report presented to the Foresight Project on communicating the evidence base for improving people's well-being. Retrieved April 2013 from <http://www.neweconomics.org/publications/five-ways-well-being-evidence>

66. Garland, E. L., & Howard, M. O. (2009). Neuroplasticity, psychosocial genomics, and the biopsychosocial paradigm in the 21st century. *Health and Social Work, 34*(3), 191-199. doi:10.1093/hsw/34.3.191
67. Bruel-Jungerman, E., Davis, S., & Laroche, S. (2007). Brain plasticity mechanisms and memory: A party of four. *Neuroscientist, 13*(5), 492-505. doi:10.1177/1073858407302725
68. Cramer, S. C., Sur, M., Dobkin, B. H., O'Brien, C., Sanger, T. D., Trojanowski, J. Q., . . . Vinogradov, S. (2011). Harnessing neuroplasticity for clinical applications. *Brain, 134*(6), 1591-1609. doi:10.1093/brain/awr039
69. Garland, E. L., Fredrickson, B., Kring, A. M., Johnson, D. P., Meyer, P. S., & Penn, D. L. (2010). Upward spirals of positive emotions counter downward spirals of negativity: insights from the broaden-and-build theory and affective neuroscience on the treatment of emotion dysfunctions and deficits in psychopathology. *Clinical Psychology Review, 30*(7), 849-864. doi:10.1016/j.cpr.2010.03.002
70. Shaffer, J. (2012). Neuroplasticity and positive psychology in clinical practice: A review for combined benefits. *Psychology, 3*(12), 1110-1115. doi:10.4236/psych.2012.312A164
71. Davidson, R. J., & McEwen, B. S. (2012). Social influences on neuroplasticity: Stress and interventions to promote well-being. *Nature Neuroscience, 15*(5), 689-695. doi:10.1038/nn.3093
72. Kays, J. L., Hurley, R. A., & Taber, K. H. (2012). The dynamic brain: Neuroplasticity and mental health. *The Journal of Neuropsychiatry & Clinical Neurosciences, 24*(2), 118-124.
73. Kilgard, M. P. (2012). Harnessing plasticity to understand learning and treat disease. *Trends in Neurosciences, 35*(12), 715-722. doi:10.1016/j.tins.2012.09.002
74. Brunoni, A. R., Lopes, M., & Fregni, F. (2008). A systematic review and meta-analysis of clinical studies on major depression and BDNF levels: Implications for the role of neuroplasticity in depression. *International Journal of Neuropsychopharmacology, 11*(8), 1169-1180. doi:10.1017/S1461145708009309
75. Pittenger, C., & Duman, R. S. (2008). Stress, depression, and neuroplasticity: a convergence of mechanisms. *Neuropsychopharmacology, 33*(1), 88-109. doi:10.1038/sj.npp.1301574
76. Cotman, C. W., & Berchtold, N. C. (2002). Exercise: A behavioral intervention to enhance brain health and plasticity. *Trends in Neurosciences, 25*(6), 295-301. doi:10.1016/S0166-2236(02)02143-4
77. Radak, Z., Marton, O., Nagy, E., Koltai, E., & Goto, S. (2013). The complex role of physical exercise and reactive oxygen species on brain. *Journal of Sport and Health Science, 2*(2), 87-93. doi:10.1016/j.jshs.2013.04.001
78. Mattson, M. P., Chan, S., & Duan, W. (2002). Modification of brain aging and neurodegenerative disorders by genes, diet, and behavior. *Physiological Reviews, 82*(3), 637-672. doi:10.1152/physrev.00004.2002.
79. Klein, A. B., Williamson, R., Santini, M. A., Clemmensen, C., Ettrup, A., Rios, M., . . . Aznar, S. (2011). Blood BDNF concentrations reflect brain-tissue BDNF levels across species. *International Journal of Neuropsychopharmacology, 14*(3), 347-353. doi:10.1017/S1461145710000738
80. Rothman, S. M., & Mattson, M. P. (2013). Activity-dependent, stress-responsive BDNF signaling and the quest for optimal brain health and resilience throughout the lifespan. *Neuroscience, 239*, 228-240. doi:10.1016/j.neuroscience.2012.10.014

81. Ding, Q., Vaynman, S., Akhavan, M., Ying, Z., & Gomez-Pinilla, F. (2006). Insulin-like growth factor I interfaces with brain-derived neurotrophic factor-mediated synaptic plasticity to modulate aspects of exercise-induced cognitive function. *Neuroscience*, 140(3), 823-833. doi:10.1016/j.neuroscience.2006.02.084
82. Mattson, M. P., Maudsley, S., & Martin, B. (2004). A neural signaling triumvirate that influences ageing and age-related disease: insulin/IGF-1, BDNF and serotonin. *Ageing Research Reviews*, 3(4), 445-464. doi:10.1016/j.arr.2004.08.001
83. Carro, E., Trejo, J. L., Busiguina, S., & Torres-Aleman, I. (2001). Circulating insulin-like growth factor 1 mediates the protective effects of physical exercise against brain insults of different etiology and anatomy. *The Journal of Neuroscience*, 21(15), 5678-5684.
84. Park, S. E., Dantzer, R., Kelley, K. W., & McCusker, R. H. (2011). Central administration of insulin-like growth factor-I decreases depressive-like behavior and brain cytokine expression in mice. *Journal of Neuroinflammation*, 8, 12. doi:10.1186/1742-2094-8-12
85. Busiguina, S., Fernandez, A. M., Barrios, V., Clark, R., Tolbert, D. L., Berciano, J., & Torres-Aleman, I. (2000). Neurodegeneration is associated to changes in serum insulin-like growth factors. *Neurobiology of Disease*, 7(6:B), 657-665. doi:10.1006/nbdi.2000.0311
86. Gracy, R., Talent, J., LKong, Y., & Conrad, C. (1999). Reactive oxygen species: The unavoidable environmental insult? *Mutation Research*, 423(1-2), 17-22. doi:10.1016/S1383-5742(99)00027-7
87. Kishida, K. T., & Klann, E. (2007). Sources and targets of reactive oxygen species in synaptic plasticity and memory. *Antioxidants & Redox Signaling*, 9(2), 233-244. doi:10.1089/ars.2007.9.ft-8
88. Massaad, C., & Klann, E. (2011). Reactive oxygen species in the regulation of synaptic plasticity and memory. *Antioxidants & Redox Signaling*, 14(10), 2013-2054. doi:10.1089/ars.2010.3208
89. Torres-Aleman, I. (2010). Toward a comprehensive neurobiology of IGF-I. *Developmental Neurobiology*, 70(5), 384-396. doi:10.1002/dneu.20778
90. McCusker, R. H., McCrea, K., Zunich, S., Dantzer, R., Broussard, S. R., Johnson, R. W., & Kelley, K. W. (2006). Insulin-like growth factor-I enhances the biological activity of brain-derived neurotrophic factor on cerebrocortical neurons. *Journal of Neuroimmunology*, 179(1-2), 186-190. doi:10.1016/j.jneuroim.2006.06.014
91. Carro, E., Nunez, A., Busiguina, S., & Torres-Aleman, I. (2000). Circulating insulin-like growth factor I mediates effects of exercise on the brain. *The Journal of Neuroscience*, 15(8), 2926-2933.
92. Radak, Z., Chung, H. Y., & Goto, S. (2008). Systemic adaptation to oxidative challenge induced by regular exercise. *Free Radical Biology and Medicine*, 44(2), 153-159. doi:10.1016/j.freeradbiomed.2007.01.029
93. Arumugam, T. V., Gleichmann, M., Tang, S. C., & Mattson, M. P. (2006). Hormesis/preconditioning mechanisms, the nervous system and aging. *Ageing Research Reviews*, 5(2), 165-178. doi:10.1016/j.arr.2006.03.003
94. Johnson, J. A., Johnson, D. A., Kraft, A. D., Calkins, M. J., Jakel, R. J., Vargas, M. R., & Chen, P. C. (2008). The Nrf2-ARE pathway: An indicator and modulator of oxidative stress in neurodegeneration. *Annals of the New York Academy of Sciences*, 1147, 61-69. doi:10.1196/annals.1427.036

95. Ji, L. L., Gomez-Cabrera, M. C., & Vina, J. (2006). Exercise and hormesis: Activation of cellular antioxidant signaling pathway. *Annals of the New York Academy of Sciences*, 1067, 425-435. doi:10.1196/annals.1354.061
96. Alzoubi, K. H., Khabour, O. F., Salah, H. A., & Abu Rashid, B. E. (2013). The combined effect of sleep deprivation and Western diet on spatial learning and memory: Role of BDNF and oxidative stress. *Journal of Molecular Neuroscience*, 50(1), 124-133. doi:10.1007/s12031-012-9881-7
97. Mattson, M. P., & Cheng, A. (2006). Neurohormetic phytochemicals: Low-dose toxins that induce adaptive neuronal stress responses. *Trends in Neurosciences*, 29(11), 632-639. doi:10.1016/j.tins.2006.09.001
98. Calabrese, E. J., Iavicoli, I., & Calabrese, V. (2013). Hormesis: its impact on medicine and health. *Human and Experimental Toxicology*, 32(2), 120-152. doi:10.1177/0960327112455069
99. Mattson, M. P. (2008). Hormesis defined. *Ageing Research Reviews*, 7(1), 1-7. doi:10.1016/j.arr.2007.08.007
100. Calabrese, E. J. (2005). Paradigm lost, paradigm found: The re-emergence of hormesis as a fundamental dose response model in the toxicological sciences. *Environmental Pollution*, 138(3), 379-411. doi:10.1016/j.envpol.2004.10.001
101. Calabrese, E. J., Bachmann, K. A., Bailer, A. J., Bolger, P. M., Borak, J., Cai, L., . . . Mattson, M. P. (2007). Biological stress response terminology: Integrating the concepts of adaptive response and preconditioning stress within a hormetic dose-response framework. *Toxicology and Applied Pharmacology*, 222(1), 122-128. doi:10.1016/j.taap.2007.02.015
102. Calabrese, E. J., & Baldwin, L. A. (2001). U-shaped dose-responses in biology, toxicology, and public health. *Annual Review of Public Health*, 22(1), 15-33. doi:10.1146/annurev.publhealth.22.1.15
103. Szuhany, K. L., Bugatti, M., & Otto, M. W. (2015). A meta-analytic review of the effects of exercise on brain-derived neurotrophic factor. *Journal of Psychiatric Research*, 60, 56-64. doi:10.1016/j.jpsychires.2014.10.003
104. Rojas Vega, S., Abel, T., Lindschulten, R., Hollmann, W., Bloch, W., & Struder, H. K. (2008). Impact of exercise on neuroplasticity-related proteins in spinal cord injured humans. *Neuroscience*, 153(4), 1064-1070. doi:10.1016/j.neuroscience.2008.03.037
105. Brunelli, A., Dimauro, I., Sgrò, P., Emerenziani, G. P., Magi, F., Baldari, C., . . . Caporossi, D. (2012). Acute exercise modulates BDNF and pro-BDNF protein content in immune cells. *Medicine and Science in Sports and Exercise*, 44(10), 1871-1880. doi:10.1249/MSS.0b013e31825ab69b
106. Babraj, J. A., Volvaard, N. B., Keast, C., Guppy, F. M., Cottrell, G., & Timmons, J. A. (2009). Extremely short duration high intensity interval training substantially improves insulin action in young healthy males. *BMC Endocrine Disorders*, 9, 3. doi:10.1186/1472-6823-9-3
107. Schwarz, A. J., Brasel, J. A., Hintz, R. L., Mohan, S., & Cooper, D. M. (1996). Acute effect of brief low- and high-intensity exercise on circulating insulin-like growth factor (IGF) I, II, and IGF-binding protein-3 and its proteolysis in young healthy men. *The Journal of Clinical Endocrinology & Metabolism*, 81(10), 3492-3497. doi:10.1210/jcem.81.10.8855791
108. Bogdanis, G. C., Stavrinou, P., Fatouros, I. G., Philippou, A., Chatzinikolaou, A., Draganidis, D., . . . Maridaki, M. (2013). Short-term high-intensity interval exercise training attenuates oxidative stress responses and improves antioxidant status in

healthy humans. *Food and Chemical Toxicology*, 61, 171-177.
doi:10.1016/j.fct.2013.05.046

109. Anderson, M. F., Åberg, M. A. I., Nilsson, M., & Eriksson, P. S. (2002). Insulin-like growth factor-I and neurogenesis in the adult mammalian brain. *Developmental Brain Research*, 134(1-2), 115-122. doi:10.1016/S0165-3806(02)00277-8
110. Radak, Z., Chung, H. Y., Koltai, E., Taylor, A. W., & Goto, S. (2008). Exercise, oxidative stress and hormesis. *Ageing Research Reviews*, 7(1), 34-42.
doi:10.1016/j.arr.2007.04.004
111. Hawley, J. A., & Gibala, M. J. (2009). Exercise intensity and insulin sensitivity: How low can you go? *Diabetologia*, 52(9), 1709-1713. doi:10.1007/s00125-009-1425-5
112. Rojas Vega, S., Struder, H. K., Vera Wahrmann, B., Schmidt, A., Bloch, W., & Hollmann, W. (2006). Acute BDNF and cortisol response to low intensity exercise and following ramp incremental exercise to exhaustion in humans. *Brain Research*, 1121(1), 59-65. doi:10.1016/j.brainres.2006.08.105
113. Ferris, L. T., Williams, J. S., & Shen, C. L. (2007). The effect of acute exercise on serum brain-derived neurotrophic factor levels and cognitive function. *Medicine and Science in Sports and Exercise*, 39(4), 728-734. doi:10.1249/mss.0b013e31802f04c7
114. Ploughman, M., Granter-Button, S., Chernenko, G., Attwood, Z., Tucker, B. A., Mearow, K. M., & Corbett, D. (2007). Exercise intensity influences the temporal profile of growth factors involved in neuronal plasticity following focal ischemia. *Brain Research*, 1150, 207-216. doi:10.1016/j.brainres.2007.02.065
115. Radak, Z., Toldy, A., Szabo, Z., Siamilis, S., Nyakas, C., Silye, G., . . . Goto, S. (2006). The effects of training and detraining on memory, neurotrophins and oxidative stress markers in rat brain. *Neurochemistry International*, 49(4), 387-392.
doi:10.1016/j.neuint.2006.02.004
116. Helmerhorst, H. J. F., Wijndaele, K., Brage, S., Wareham, N. J., & Ekelund, U. (2009). Objectively measured sedentary time may predict insulin resistance independent of moderate- and vigorous-intensity physical activity. *Diabetes*, 58(8), 1776-1779.
117. Laufs, U., Wassmann, S., Czech, T., Munzel, T., Eisenhauer, M., Bohm, M., & Nickenig, G. (2005). Physical inactivity increases oxidative stress, endothelial dysfunction, and atherosclerosis. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 25(4), 809-814.
doi:10.1161/01.ATV.0000158311.24443.af
118. Duan, W., Lee, J. W., Guo, Z. H., & Mattson, M. P. (2001). Dietary restriction stimulates BDNF production in the brain and thereby protects neurons against excitotoxic injury. *Journal of Molecular Neuroscience*, 16(1), 1-12. doi:10.1385/JMN:16:1:1
119. Harvie, M., Wright, C., Pegington, M., McMullan, D., Mitchell, E., Martin, B., . . . Howell, A. (2013). The effect of intermittent energy and carbohydrate restriction v. daily energy restriction on weight loss and metabolic disease risk markers in overweight women. *The British Journal of Nutrition*, 10.1017/S0007114513000792, 1-14.
doi:10.1017/S0007114513000792
120. Harvie, M. N., Pegington, M., Mattson, M. P., Frystyk, J., Dillon, B., Evans, G., . . . Howell, A. (2011). The effects of intermittent or continuous energy restriction on weight loss and metabolic disease risk markers: a randomized trial in young overweight women. *International Journal of Obesity*, 35(5), 714-727. doi:10.1038/ijo.2010.171
121. Esmailzadeh, A., Kimiagar, M., Mehrabi, Y., Azadbakht, L., Hu, F. B., & Willett, W. C. (2007). Dietary patterns, insulin resistance, and prevalence of the metabolic syndrome in women. *The American Journal of Clinical Nutrition*, 85(3), 910-918.

122. Tran, C. D., Diorio, C., Bérubé, S., Pollak, M., & Brisson, J. (2006). Relation of insulin-like growth factor (IGF) I and IGF-binding protein 3 concentrations with intakes of fruit, vegetables, and antioxidants. *The American Journal of Clinical Nutrition*, 84(6), 1518-1526.
123. Molteni, R., Barnard, R. J., Ying, Z., Roberts, C. K., & Gomez-Pinilla, F. (2002). A high-fat, refined sugar diet reduces hippocampal brain-derived neurotrophic factor, neuronal plasticity, and learning. *Neuroscience*, 112(4), 803-814. doi:10.1016/S0306-4522(02)00123-9
124. Stranahan, A. M., Norman, E. D., Lee, K., Cutler, R. G., Telljohann, R. S., Egan, J. M., & Mattson, M. P. (2008). Diet-induced insulin resistance impairs hippocampal synaptic plasticity and cognition in middle-aged rats. *Hippocampus*, 18(11), 1085-1088. doi:10.1002/hipo.20470
125. Kim, E., Sohn, S., Lee, M., Jung, J., Kineman, R. D., & Park, S. (2006). Differential responses of the growth hormone axis in two rat models of streptozotocin-induced insulinopenic diabetes. *The Journal of Endocrinology*, 188(2), 263-270. doi:10.1677/joe.1.06501
126. Bonnard, C., Durand, A., Peyrol, S., Chanseaux, E., Chauvin, M.-A., Morio, B., . . . Rieusset, J. (2008). Mitochondrial dysfunction results from oxidative stress in the skeletal muscle of diet-induced insulin-resistant mice. *The Journal of Clinical Investigation*, 118(2), 789–800. doi:10.1172/jci32601ds1
127. Guzman-Marin, R., Ying, Z., Suntsova, N., Methippara, M., Bashir, T., Szymusiak, R., . . . McGinty, D. (2006). Suppression of hippocampal plasticity-related gene expression by sleep deprivation in rats. *The Journal of Physiology*, 575(Pt 3), 807-819. doi:10.1113/jphysiol.2006.115287
128. Chen, H., Zhao, Z., Zheng, J., Chen, X., Zou, J., Shi, Y., & Liu, Z. (2014). The effect of IGF-1 on symptoms of sleep deprivation in a rat model of inflammatory heart disease and metabolic syndrome. *Biochemical and Biophysical Research Communications*, 446(4), 843-849. doi:10.1016/j.bbrc.2014.02.123
129. Joe, K. H., Kim, Y. K., Kim, T. S., Roh, S. W., Choi, S. W., Kim, Y. B., . . . Kim, D. J. (2007). Decreased plasma brain-derived neurotrophic factor levels in patients with alcohol dependence. *Alcoholism: Clinical and Experimental Research*, 31(11), 1833-1838. doi:10.1111/j.1530-0277.2007.00507.x
130. Lindtner, C., Scherer, T., Zielinski, E., Filatova, N., Fasshauer, M., Tonks, N. K., . . . Buettner, C. (2013). Binge drinking induces whole-body insulin resistance by impairing hypothalamic insulin action. *Science Translational Medicine*, 5(170). doi:10.1126/scitranslmed.3005123
131. Lang, C., Fan, J., Lipton, B., Potter, B., & McDonough, K. (1998). Modulation of the insulin-like growth factor system by chronic alcohol feeding. *Alcoholism: Clinical and Experimental Research*, 22(4), 823-829.
132. Das, S. K., & Vasudevan, D. M. (2007). Alcohol-induced oxidative stress. *Life Sciences*, 81(3), 177-187. doi:10.1016/j.lfs.2007.05.005
133. Krabbe, K. S., Nielsen, A. R., Krogh-Madsen, R., Plomgaard, P., Rasmussen, P., Erikstrup, C., . . . Pedersen, B. K. (2007). Brain-derived neurotrophic factor (BDNF) and type 2 diabetes. *Diabetologia*, 50(2), 431-438. doi:10.1007/s00125-006-0537-4
134. Kreutzmann, J. C., Havekes, R., Abel, T., & Meerlo, P. (2015). Sleep deprivation and hippocampal vulnerability: Changes in neuronal plasticity, neurogenesis and cognitive function. *Neuroscience*, 309, 173-190. doi:10.1016/j.neuroscience.2015.04.053

135. Mirescu, C., Peters, J. D., Noiman, L., & Gould, E. (2006). Sleep deprivation inhibits adult neurogenesis in the hippocampus by elevating glucocorticoids. *Proceedings of the National Academy of Sciences*, 103(50), 19170-19175. doi:10.1073/pnas.0608644103
136. Gonnissen, H. K., Hursel, R., Rutters, F., Martens, E. A., & Westerterp-Plantenga, M. S. (2013). Effects of sleep fragmentation on appetite and related hormone concentrations over 24 h in healthy men. *The British Journal of Nutrition*, 109(4), 748-756. doi:10.1017/S0007114512001894
137. Wong, P. M., Manuck, S. B., DiNardo, M. M., Korytkowski, M., & Muldoon, M. F. (2015). Shorter sleep duration is associated with decreased insulin sensitivity in healthy white men. *Sleep*, 38(2), 223-231. doi:10.5665/sleep.4402
138. Fujihara, H., Sei, H., Morita, Y., Ueta, Y., & Morita, K. (2003). Short-term sleep disturbance enhances brain-derived neurotrophic factor gene expression in rat hippocampus by acting as internal stressor. *Journal of Molecular Neuroscience*, 21(3), 223-232. doi:10.1385/JMN:21:3:223
139. Faraguna, U., Vyazovskiy, V. V., Nelson, A. B., Tononi, G., & Cirelli, C. (2008). A causal role for brain-derived neurotrophic factor in the homeostatic regulation of sleep. *The Journal of Neuroscience*, 28(15), 4088-4095. doi:10.1523/JNEUROSCI.5510-07.2008
140. Zisapel, N. (2007). Sleep and sleep disturbances: Biological basis and clinical implications. *Cellular and Molecular Life Sciences*, 64(10), 1174-1186. doi:10.1007/s00018-007-6529-9
141. Aschbacher, K., Kornfeld, S., Picard, M., Puterman, E., Havel, P. J., Stanhope, K., . . . Epel, E. (2014). Chronic stress increases vulnerability to diet-related abdominal fat, oxidative stress, and metabolic risk. *Psychoneuroendocrinology*, 46, 14-22. doi:10.1016/j.psyneuen.2014.04.003
142. Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1(3), 385-401.
143. Beck, A., Brown, G., Epstein, N., & Steer, R. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology*, 56(6), 893-897.
144. Gable, S. L., & Haidt, J. (2005). What (and why) is positive psychology? *Review of General Psychology*, 9(2), 103-110. doi:10.1037/1089-2680.9.2.103
145. Linley, P. A., Joseph, S., Harrington, S., & Wood, A. M. (2006). Positive psychology: Past, present, and (possible) future. *The Journal of Positive Psychology*, 1(1), 3-16. doi:10.1080/17439760500372796
146. Sheldon, K. M., & King, L. (2001). Why positive psychology is necessary. *American Psychologist*, 56(3), 216-217. doi:10.1037//0003-066X.56.3.216
147. Biswas-Diener, R., Vittersø, J., & Diener, E. (2009). The Danish effect: Beginning to explain high well-being in Denmark. *Social Indicators Research*, 97(2), 229-246. doi:10.1007/s11205-009-9499-5
148. Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, 52(1), 141-166. doi:10.1146/annurev.psych.52.1.141
149. Kashdan, T. B., Biswas-Diener, R., & King, L. A. (2008). Reconsidering happiness: the costs of distinguishing between hedonics and eudaimonia. *The Journal of Positive Psychology*, 3(4), 219-233. doi:10.1080/17439760802303044

150. Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57(6), 1069-1081. doi:0022-3514/89/SOO. 75
151. Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology*, 69(4), 719-727. doi:10.1037/0022-3514.69.4.719
152. Delle Fave, A., & Bassi, M. (2009). The contribution of diversity to happiness research. *The Journal of Positive Psychology*, 4(3), 205-207. doi:10.1080/17439760902844319
153. Henderson, L., & Knight, T. (2012). Integrating the hedonic and eudaimonic perspectives to more comprehensively understand wellbeing and pathways to wellbeing. *International Journal of Wellbeing*, 2(3), 196-221. doi:10.5502/ijw.v2i3.3
154. Schotanus-Dijkstra, M., Pieterse, M. E., Drossaert, C. H. C., Westerhof, G. J., de Graaf, R., ten Have, M., . . . Bohlmeijer, E. T. (2015). What factors are associated with flourishing? Results from a large representative national sample. *Journal of Happiness Studies*. doi:10.1007/s10902-015-9647-3
155. Butler, J., & Kern, M. L. (2015). The PERMA-Profilr: A brief multidimensional measure of flourishing. Retrieved from www.peggykern.org/uploads/5/6/6/7/56678211/the_perma-profiler_092515.pdf
156. Diener, E. (2000). Subjective well-being: The science of happiness and a proposal for a national index. *American Psychologist*, 55(1), 34-43. doi:10.1037/0003-066X.55.1.34
157. Keyes, C. L. (2005). Mental illness and/or mental health? Investigating axioms of the complete state model of health. *Journal of Consulting and Clinical Psychology*, 73(3), 539-548. doi:10.1037/0022-006X.73.3.539
158. Keyes, C. L. M. (2007). Promoting and protecting mental health as flourishing: A complementary strategy for improving national mental health. *American Psychologist*, 62(2), 95-108. doi:10.1037/0003-066x.62.2.95
159. Gordis, L. (2014). *Epidemiology* (5 ed.). Baltimore, Maryland: Saunders, Elsevier Inc.
160. Lamers, S. M., Westerhof, G. J., Bohlmeijer, E. T., ten Klooster, P. M., & Keyes, C. L. (2011). Evaluating the psychometric properties of the Mental Health Continuum-Short Form (MHC-SF). *Journal of Clinical Psychology*, 67(1), 99-110. doi:10.1002/jclp.20741
161. Diener, E., Lucas, R. E., Schimmack, U., & Helliwell, J. F. (2009). *Well-being for public policy*. New York: Oxford University Press, Inc.
162. Barry, M. M. (2009). Addressing the determinants of positive mental health: Concepts, evidence and practice. *International Journal of Mental Health Promotion*, 11(3), 4-17. doi:10.1080/14623730.2009.9721788
163. Keyes, C. L. M., & Simoes, E. J. (2012). To flourish or not: Positive mental health and all-cause mortality. *American Journal of Public Health*, 102(11), 2164-2172. doi:10.2105/AJPH.2012.300918
164. Hone, L., Jarden, A., & Schofield, G. (2013). Psychometric properties of the flourishing scale in a New Zealand sample. *Social Indicators Research*, 119(2), 1031-1045. doi:10.1007/s11205-013-0501-x
165. Conner, T. S., Brookie, K. L., Richardson, A. C., & Polak, M. A. (2015). On carrots and curiosity: Eating fruit and vegetables is associated with greater flourishing in daily life. *British Journal of Health Psychology*, 20(2), 413-427. doi:10.1111/bjhp.12113

166. Ministry of Health. (2016). *New Zealand health survey*. Retrieved 04 March, 2016, from www.health.govt.nz/nz-health-statistics/national-collections-and-surveys/surveys/current-recent-surveys/new-zealand-health-survey
167. Ministry of Health. (2015). *Questionnaires and content guide 2014/15: New Zealand health survey*. Retrieved 04 March, 2016, from <http://www.health.govt.nz/publication/questionnaires-and-content-guide-2014-15-new-zealand-health-survey>
168. Statistics New Zealand. (2016). *New Zealand General Social Survey: Information releases*. Retrieved 04 March, 2016, from www.stats.govt.nz/browse_for_stats/people_and_communities/well-being/nzgss-info-releases.aspx
169. Statistics New Zealand. (2013). *New Zealand General Social Survey: 2012*. Wellington: Statistics New Zealand.
170. Mental Health Foundation of New Zealand. (2016). Strategic approach: 2016-2020. Retrieved from <https://www.mentalhealth.org.nz/assets/StayingWell/Reports/MHF-Strategic-Approach-2016-2020-Web.pdf>
171. New Economics Foundation. (N.D.). *nef*. Retrieved 22 February, 2016, from www.neweconomics.org/
172. Mental Health Foundation. (2012). *Five ways to wellbeing*. Retrieved 12 March, 2016, from <http://www.mentalhealth.org.nz/page/1180-5-ways-to-wellbeing>
173. Glanz, K., & Bishop, D. B. (2010). The role of behavioral science theory in development and implementation of public health interventions. *Annual Review of Public Health*, 31, 399-418. doi:10.1146/annurev.publhealth.012809.103604
174. Glanz, K., Rimer, B., & Viswanath, K. (Eds.). (2008). *Health behaviour and health education: Theory, research, and practice* (4 ed.). San Francisco: Jossey-Bass.
175. Hone, L., Schofield, G., & Jarden, A. (2015). Conceptualizations of wellbeing: Insights from a prototype analysis on New Zealand workers. *NZ Journal of Human Resources Management*, 15(2), 97-118.
176. World Health Organization. (2016). *Public health*. Retrieved 11 March, 2016, from www.who.int/trade/glossary/story076/en/
177. Irvine, L. (2006). A review of major influences on current public health policy in developed countries in the second half of the 20th century. *The Journal of the Royal Society for the Promotion of Health*, 126(2), 73-78. doi:10.1177/1466424006063182
178. Ministry of Health. (2015). Annual update of key results 2014/15: The New Zealand health survey. Retrieved from <http://www.health.govt.nz/system/files/documents/publications/annual-update-key-results-2014-15-nzhs-dec15-1.pdf>
179. Ministry of Health. (2012). The health of New Zealand adults 2011/12: Key findings of the New Zealand health survey. Retrieved from <http://www.health.govt.nz/publication/health-new-zealand-adults-2011-12>
180. Ministry of Health. (2012). *New Zealand food and nutrition guideline statements for healthy adults*. Retrieved 05 March, 2014, from www.health.govt.nz/our-work/preventative-health-wellness/nutrition/food-and-nutrition-guidelines/nz-food-and-nutrition-guideline-statements-healthy-adults
181. Ministry of Health. (2014). *Physical activity*. Retrieved 05 March, 2014, from www.health.govt.nz/our-work/preventative-health-wellness/physical-activity

182. Pam Oliver & Associates. (2011). Evaluation of the food and nutrition guidelines series. Retrieved from www.health.govt.nz/publication/evaluation-food-and-nutrition-guidelines-series
183. Powell, K. E., Paluch, A. E., & Blair, S. N. (2011). Physical activity for health: What kind? How much? How intense? On top of what? *Annual Review of Public Health*, 32, 349-365. doi:10.1146/annurev-publhealth-031210-101151
184. Brown, W., Bauman, A., Bull, F., & Burton, N. (2012). Development of evidence-based physical activity recommendations for adults (18-64 years). *Report prepared for the Australian Government Department of Health*. Retrieved from [http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines/\\$File/DEB-PAR-Adults-18-64years.pdf](http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines/$File/DEB-PAR-Adults-18-64years.pdf)
185. Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: Review and update. *Medicine and Science in Sports and Exercise*, 34(12), 1996-2001. doi:10.1249/01.MSS.0000038974.76900.92
186. Harris, N., Schofield, G., White, K., & Mackay, L. (2014). *Response to draft physical activity guidelines submitted to the Ministry of Health April 2014*. Auckland: Human Potential Centre.
187. Sedentary Behaviour Research, N. (2012). Letter to the editor: Standardized use of the terms "sedentary" and "sedentary behaviours". *Applied Physiology, Nutrition, and Metabolism*, 37(3), 540-542. doi:10.1139/h2012-024
188. Chastin, S. F., Egerton, T., Leask, C., & Stamatakis, E. (2015). Meta-analysis of the relationship between breaks in sedentary behavior and cardiometabolic health. *Obesity*, 23(9), 1800-1810. doi:10.1002/oby.21180
189. Ministry of Health. (2003). *Food and nutrition guidelines for healthy adults: A background paper*. Wellington: Ministry of Health.
190. Heart Foundation. (2015). *New 'Healthy Heart' visual food guide*. Retrieved 12 June 2015, from www.heartfoundation.org.nz/healthy-living/healthy-eating/healthy-heart-visual-food-guide
191. World Health Organization. (2015). *Sugars intake for adults and children*. Geneva: World Health Organisation.
192. Mente, A., de Koning, L., Shannon, H. S., & Anand, S. S. (2009). A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. *Archives of Internal Medicine*, 169(7), 659-669. doi:10.1001/archinternmed.2009.38
193. Perry, G. S., Patil, S. P., & Presley-Cantrell, L. R. (2013). Raising awareness of sleep as a healthy behavior. *Preventing Chronic Disease*, 10, E133. doi:10.5888/pcd10.130081
194. Meltzer, L. J., Moreno, J. P., & Johnston, C. A. (2014). Sleep is not for slackers. *American Journal of Lifestyle Medicine*, 8(6), 380-382. doi:10.1177/1559827614545314
195. Spiegel, K., Tasali, E., Penev, P., & Eve, V. C. (2004). Brief communication: Sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite. *Annals of Internal Medicine*, 141(11), 846-850.
196. Guyon, A., Balbo, M., Morselli, L. L., Tasali, E., Leproult, R., L'Hermite-Balériaux, M., . . . Spiegel, K. (2014). Adverse effects of two nights of sleep restriction on the hypothalamic-pituitary-adrenal axis in healthy men. *The Journal of Clinical Endocrinology & Metabolism*, 99(8), 2861-2868. doi:10.1210/jc.2013-4254

197. Simpson, N., & Dinges, D. F. (2007). Sleep and inflammation. *Nutrition Reviews*, 65(12), 244-252. doi:10.1301/nr.2007.dec.S244-S252
198. Krueger, P. M., & Friedman, E. M. (2009). Sleep duration in the United States: A cross-sectional population-based study. *American Journal of Epidemiology*, 169(9), 1052-1063. doi:10.1093/aje/kwp023
199. Cajochen, C., Frey, S., Anders, D., Späti, J., Bues, M., Pross, A., . . . Stefani, O. (2011). Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance. *Journal of Applied Physiology*, 110(5), 1432-1438. doi:10.1152/japplphysiol.00165.2011
200. Chang, A.-M., Aeschbach, D., Duffy, J. F., & Czeisler, C. A. (2015). Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proceedings of the National Academy of Sciences*, 112(4), 1232-1237. doi:10.1073/pnas.1418490112
201. Shilo, L., Sabbah, H., Hadari, R., Kovatz, S., Weinberg, U., Dolev, S., . . . Shenkman, L. (2002). The effects of coffee consumption on sleep and melatonin secretion. *Sleep Medicine*, 3(3), 271-273. doi:10.1016/S1389-9457(02)00015-1
202. Ebrahim, I. O., Shapiro, C. M., Williams, A. J., & Fenwick, P. B. (2013). Alcohol and sleep I: Effects on normal sleep. *Alcoholism: Clinical and Experimental Research*, 37(4), 539-549. doi:10.1111/acer.12006
203. Buman, M. P., Phillips, B. A., Youngstedt, S. D., Kline, C. E., & Hirshkowitz, M. (2014). Does nighttime exercise really disturb sleep? Results from the 2013 National Sleep Foundation Sleep in America Poll. *Sleep Medicine*, 15(7), 755-761. doi:10.1016/j.sleep.2014.01.008
204. Berrigan, D., Dodd, K., Troiano, R. P., Krebs-Smith, S. M., & Barbash, R. B. (2003). Patterns of health behavior in U.S. adults. *Preventive Medicine*, 36(5), 615-623. doi:10.1016/s0091-7435(02)00067-1
205. Poortinga, W. (2007). The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Preventive Medicine*, 44(2), 124-128. doi:10.1016/j.ypmed.2006.10.006
206. Laaksonen, M., Prattala, R., & Karisto, A. (2001). Patterns of unhealthy behaviour in Finland. *European Journal of Public Health*, 11(3), 294-300.
207. Tamakoshi, A., Tamakoshi, K., Lin, Y., Yagyu, K., Kikuchi, S., & Group, J. S. (2009). Healthy lifestyle and preventable death: Findings from the Japan Collaborative Cohort (JACC) Study. *Preventive Medicine*, 48(5), 486-492. doi:10.1016/j.ypmed.2009.02.017
208. Ryff, C. D., Singer, B., & Love, G. D. (2004). Positive health: connecting well-being with biology. *Philosophical transactions of the Royal Society of London*, 359(1449), 1383-1394. doi:10.1098/rstb.2004.1521
209. Jarden, A., Mackay, L., White, K., Schofield, G., Williden, M., Hone, L., & McPhee, J. (2013). The Sovereign New Zealand Wellbeing Index. *Psychology Aotearoa*, 5(1), 22-27.
210. van Gelder, M. M., Bretveld, R. W., & Roeleveld, N. (2010). Web-based questionnaires: the future in epidemiology? *American Journal of Epidemiology*, 172(11), 1292-1298. doi:10.1093/aje/kwq291
211. Statistics New Zealand. (2013). Household use of information and communication technology: 2012. Retrieved from http://www.stats.govt.nz/browse_for_stats/industry_sectors/information_technology_and_communications/HouseholdUseofICT_HOTP2012/Commentary.aspx

212. Statistics New Zealand. (2015). *2013 Census QuickStats about transport and communications*. Retrieved 18 November, 2015, from <http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-transport-comms.aspx>
213. SmileCity Ltd. (2012). *ESOMAR: 27 Questions*. Auckland: SmileCity Ltd.
214. European Social Survey. (2012). *ESS Round 6 source questionnaire*. London: Centre for Comparative Social Surveys, City University.
215. Ministry of Health. (2006). *2006/07 New Zealand health survey: adult questionnaire*. Wellington: Ministry of Health.
216. European Social Survey. (2013). Round 6 module on personal and social wellbeing: final module in template. Retrieved from https://www.europeansocialsurvey.org/docs/round6/questionnaire/ESS6_final_personal_and_social_well_being_module_template.pdf
217. Statistics New Zealand. (n.d.). *Statistical standard for ethnicity*. Retrieved 09 December, 2012, from http://www.stats.govt.nz/surveys_and_methods/methods/classifications-and-standards/classification-related-stats-standards/ethnicity.aspx
218. Statistics New Zealand. (n.d.). *Statistical standard for age*. Retrieved 09 December, 2015, from http://www.stats.govt.nz/surveys_and_methods/methods/classifications-and-standards/classification-related-stats-standards/age.aspx
219. Sullivan, C., Oakden, J., Young, J., Butcher, H., & Lawson, R. (2003). *Obstacles to action: A study of New Zealanders' physical activity and nutrition, Technical report*. Wellington: AC Neilson.
220. Baecke, J. A. H., Burema, J., & Frijters, E. R. (1982). A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *American Journal of Clinical Nutrition*, 36, 936-942.
221. European Social Survey. (2006). *ESS Round 3 source questionnaire*. London: Centre for Comparative Social Surveys, City University London.
222. Burgard, S. A., & Ailshire, J. A. (2009). Putting work to bed: Stressful experiences on the job and sleep quality. *Journal of Health and Social Behavior*, 50(4), 476-492.
223. Kutner, N. G., Bliwise, D. L., & Zhang, R. (2004). Linking race and well-being within a biopsychosocial framework: variation in subjective sleep quality in two racially diverse older adult samples. *Journal of Health and Social Behavior*, 45(1), 99-113.
224. World Health Organization: Europe. (2015). *Body mass index: BMI*. Retrieved 09 December, 2015, from www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi
225. Statistics New Zealand. (n.d.). *Population estimates*. Retrieved 2015, 09 December, from www.stats.govt.nz/infoshare/SelectVariables.aspx?pxID=598e3be1-1c95-494c-ba1a-af1101e65492
226. Diener, E., & Diener, M. (1995). Cross-cultural correlates of life satisfaction and self-esteem. *Journal of Personality and Social Psychology*, 68(4), 653-663.
227. Croft, A. G. W., & Lawson, R. (2008). Applying the international wellbeing index to investigate subjective wellbeing of New Zealanders with European and with Maori heritage. *Kotuitui: New Zealand Journal of Social Sciences Online*, 3(1), 57-72. doi:10.1080/1177083x.2008.9522432

228. Sibley, C., Harré, N., Hoverd, W., & Houkamau, C. (2011). The gap in the subjective wellbeing of Māori and New Zealand Europeans widened between 2005 and 2009. *Social Indicators Research*, 104(1), 103-115. doi:10.1007/s11205-010-9729-x
229. Chant, L. (2011). Whanau ora: Hauora Maori models for kotahitanga/co-operative co-existence with non-Maori. *AlterNative: An International Journal of Indigenous Peoples*, 7(2), 111-122.
230. Cappuccio, F. P., D'Elia, L., Strazzullo, P., & Miller, M. A. (2010). Sleep duration and all-cause mortality: A systematic review and meta-analysis of prospective studies. *Sleep*, 33(5), 585-592.
231. Salovey, P., Detweiler, J. B., Steward, W. T., & Rothman, A. J. (2000). Emotional states and physical health. *American Psychologist*, 55(1), 110-121.
232. Sharma, S., & Fulton, S. (2013). Diet-induced obesity promotes depressive-like behaviour that is associated with neural adaptations in brain reward circuitry. *International Journal of Obesity*, 37(3), 382-389. doi:10.1038/ijo.2012.48
233. Kim, J. H., Kim, S. J., Lee, W. Y., Cheon, Y. H., Lee, S. S., Ju, A., . . . Kim, D. J. (2013). The effects of alcohol abstinence on BDNF, ghrelin, and leptin secretions in alcohol-dependent patients with glucose intolerance. *Alcoholism: Clinical and Experimental Research*, 37(S1), e52-58. doi:10.1111/j.1530-0277.2012.01921.x
234. Sei, H., Saitoh, D., Yamamoto, K., Morita, K., & Morita, Y. (2000). Differential effect of short-term REM sleep deprivation on NGF and BDNF protein levels in the rat brain. *Brain Research*, 877(2), 387-390. doi:10.1016/S0006-8993(00)02708-6
235. Prendergast, K. B., Schofield, G. M., & Mackay, L. M. (2016). Associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults. *BMC Public Health*, 16(1). doi:10.1186/s12889-016-2755-0
236. Walsh, R. (2011). Lifestyle and mental health. *American Psychologist*, 66(7), 579-592.
237. Conry, M. C., Morgan, K., Curry, P., McGee, H., Harrington, J., Ward, M., & Shelley, E. (2011). The clustering of health behaviours in Ireland and their relationship with mental health, self-rated health and quality of life. *BMC Public Health*, 10.1186/1471-2458-11-692. doi:10.1186/1471-2458-11-692
238. McAloney, K., Graham, H., Law, C., & Platt, L. (2013). A scoping review of statistical approaches to the analysis of multiple health-related behaviours. *Preventive Medicine*, 56(6), 365-371. doi:10.1016/j.ypmed.2013.03.002
239. Pronk, N. P., Anderson, L. H., Crain, A. L., Martinson, B. C., O'Connor, P. J., Sherwood, N. E., & Whitebird, R. R. (2004). Meeting recommendations for multiple healthy lifestyle factors: Prevalence, clustering, and predictors among adolescent, adult, and senior health plan members. *American Journal of Preventive Medicine*, 27(S2), 25-33. doi:10.1016/j.amepre.2004.04.022
240. Tobias, M., Jackson, G., Yeh, L.-C., & Huang, K. (2007). Do healthy and unhealthy behaviours cluster in New Zealand? *Australian and New Zealand Journal of Public Health*, 31(2), 155-163. doi:10.1111/j.1753-6405.2007.00034.x
241. Williden, M., Duncan, S., & Schofield, G. (2012). Do health behaviours cluster in a working population in New Zealand? *Health Promotion Journal of Australia*, 23(3), 234-236.
242. Baruth, M., Addy, C., Wilcox, S., & Dowda, M. (2011). Clustering of risk behaviours among African American adults. *Health Education Journal*, 71(5), 565-575. doi:10.1177/0017896911411761

243. French, S., Rosenberg, M., & Knuiman, M. (2008). The clustering of health behaviours in a Western Australian adult population. *Health Promotion Journal of Australia*, 19(3), 203-209.
244. Brown, C. M., Dulloo, A. G., & Montani, J. P. (2008). Sugary drinks in the pathogenesis of obesity and cardiovascular diseases. *International Journal of Obesity*, 32 (S6), S28-34. doi:10.1038/ijo.2008.204
245. Atkin, A., Adams, E., Bull, F., & Biddle, S. (2012). Non-occupational sitting and mental well-being in employed adults. *Annals of Behavioral Medicine*, 43(2), 181-188. doi:10.1007/s12160-011-9320-y
246. Hone, L. C., Jarden, A., Duncan, S., & Schofield, G. M. (2015). Flourishing in New Zealand workers: Associations with lifestyle behaviors, physical health, psychosocial, and work-related indicators. *Journal of Occupational and Environmental Medicine*, 57(9), 973-983. doi:10.1097/JOM.0000000000000508
247. Ministry of Health. (2015). Eating and activity guidelines for New Zealand adults. Retrieved from http://www.health.govt.nz/system/files/documents/publications/eating-activity-guidelines-for-new-zealand-adults-oct15_0.pdf
248. Ebrahim, S., Montaner, D., & Lawlor, D. A. (2004). Clustering of risk factors and social class in childhood and adulthood in British women's heart and health study: Cross sectional analysis. *British Medical Journal*, 10.1136/bmj.38034.702836.55. doi:10.1136/bmj.38034.702836.55
249. Wicker, P., Coates, D., & Breuer, C. (2015). The effect of a four-week fitness program on satisfaction with health and life. *Int J Public Health*, 60(1), 41-47. doi:10.1007/s00038-014-0601-7
250. Mattson, M. P. (2008). Dietary factors, hormesis and health. *Ageing Research Reviews*, 7(1), 43-48. doi:10.1016/j.arr.2007.08.004
251. Spring, B., Moller, A. C., & Coons, M. J. (2012). Multiple health behaviours: Overview and implications. *J Public Health*, 34(S1), S3-10. doi:10.1093/pubmed/fdr111
252. Lustig, R. H. (2008). Which comes first? The obesity or the insulin? The behavior or the biochemistry? *The Journal of Pediatrics*, 152(5), 601-602. doi:10.1016/j.jpeds.2008.01.021
253. Mark, A. L., Rahmouni, K., Correia, M., & Haynes, W. G. (2003). A leptin-sympathetic-leptin feedback loop: Potential implications for regulation of arterial pressure and body fat. *Acta Physiologica Scandinavica*, 177(3), 345-349. doi:10.1046/j.1365-201X.2003.01085.x
254. Isganaitis, E., & Lustig, R. H. (2005). Fast food, central nervous system insulin resistance, and obesity. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 25(12), 2451-2462. doi:10.1161/01.ATV.0000186208.06964.91
255. Lustig, R. H., Sen, S., Soberman, J. E., & Velasquez-Mieyer, P. A. (2004). Obesity, leptin resistance, and the effects of insulin reduction. *International Journal of Obesity and Related Metabolic Disorders*, 28(10), 1344-1348. doi:10.1038/sj.ijo.0802753
256. Prendergast, K. B., Mackay, L. M., & Schofield, G. M. (2016). The clustering of lifestyle behaviours in New Zealand and their relationship with optimal wellbeing. *International Journal of Behavioral Medicine*, 10.1007/s12529-016-9552-0. doi:10.1007/s12529-016-9552-0
257. Buck, D., & Frosini, F. (2012). Clustering of unhealthy behaviours over time: Implications for policy and practice. Retrieved from

http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/clustering-of-unhealthy-behaviours-over-time-aug-2012.pdf

258. Watson, R., & Wyness, L. (2013). 'Don't tell me what to eat!': Ways to engage the population in positive behaviour change. *Nutrition Bulletin*, 38(1), 23-29. doi:10.1111/nbu.12003
259. Australian Government: National Health and Medical Research Council, & Department of Health and Ageing. (2013). Eat for health: Australian dietary guidelines. Retrieved from www.nhmrc.gov.au/_files_nhmrc/publications/attachments/n55a_australian_dietary_guidelines_summary_131014.pdf
260. Australian Government: Department of Health. (2012). *Australia's physical activity and sedentary behaviour guidelines*. Retrieved 1 September 2015, from www.health.gov.au/internet/main/publishing.nsf/content/health-pubhlth-strateg-phys-act-guidelines#apaadult
261. Health Canada. (2007). Eating well with Canada's food guide. Retrieved from www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/food-guide-aliment/view_eatwell_vue_bienmang-eng.pdf
262. Tremblay, M. S., Warburton, D. E., Janssen, I., Paterson, D. H., Latimer, A. E., Rhodes, R. E., . . . Duggan, M. (2011). New Canadian physical activity guidelines. *Applied Physiology, Nutrition, and Metabolism*, 36(1), 36-46. doi:10.1139/H11-009
263. Chaput, J.-P. (2014). Sleep patterns, diet quality and energy balance. *Physiology and Behavior*, 134, 86-91. doi:10.1016/j.physbeh.2013.09.006
264. Sandelowski, M. (2000). Focus on research methods: Whatever happened to qualitative description? *Research in Nursing and Health*, 23(4), 334-340.
265. McLafferty, I. (2004). Focus group interviews as a data collecting strategy. *Journal of Advanced Nursing*, 48(2), 187-194. doi:10.1111/j.1365-2648.2004.03186.x
266. Heart Foundation. (2015). *Heart Foundation tick*. Retrieved 12 May, 2015, from www.heartfoundation.org.nz/healthy-living/healthy-eating/heart-foundation-tick
267. 5+ A Day. (2011). *What is 5+ A Day®?* Retrieved 24 April, 2013, from www.5aday.co.nz/5aday.html
268. Health Promotion Agency. (N.D.). *Breakfast eaters*. Retrieved 12 June, 2015, from www.breakfast-eaters.org.nz/
269. Sport Waitakere. (2015). *Push play*. Retrieved 12 June, 2015, from www.sportwaitakere.co.nz/get-active/push-play/
270. Bauman, A., McLean, G., Hurdle, D., Walker, S., Boyd, J., van Aalst, I., & Carr, H. (2003). Evaluation of the national 'Push Play' campaign in New Zealand: Creating population awareness of physical activity. *The New Zealand Medical Journal*, 116(1179). Retrieved from www.nzma.org.nz/journal/116-1179/535/
271. Cizza, G., Marincola, P., Mattingly, M., Williams, L., Mitler, M., Skarulis, M., & Csako, G. (2010). Treatment of obesity with extension of sleep duration: A randomized, prospective, controlled trial. *Clinical Trials*, 7(3), 274-285. doi:10.1177/1740774510368298
272. Chapman, C. D., Benedict, C., Brooks, S. J., & Schioth, H. B. (2012). Lifestyle determinants of the drive to eat: A meta-analysis. *American Journal of Clinical Nutrition*, 96(3), 492-497. doi:10.3945/ajcn.112.039750

273. King, K., Meader, N., Wright, K., Graham, H., Power, C., Petticrew, M., . . . Sowden, A. J. (2015). Characteristics of interventions targeting multiple lifestyle risk behaviours in adult populations: A systematic scoping review. *PloS One*, 10(1), e0117015. doi:10.1371/journal.pone.0117015
274. Hart, K. H., Herriot, A., Bishoop, J. A., & Truby, H. (2003). Promoting healthy diet and exercise patterns amongst primary school children: a qualitative investigation of parental perspectives. *Journal of Human Nutrition and Dietetics*, 16(2), 89-96.
275. Hesse, B. W., Nelson, D. E., Kreps, G. L., Croyle, R. T., Arora, N. K., Rimer, B. K., & Viswanath, K. (2005). Trust and sources of health information: The impact of the internet and its implications for health care providers: Findings from the first health information national trends survey. *Archives of Internal Medicine*, 165(12), 2618-2624.
276. Berry, T. R., Witcher, C., Holt, N. L., & Plotnikoff, R. C. (2010). A qualitative examination of perceptions of physical activity guidelines and preferences for format. *Health Promotion Practice*, 11(6), 908-916. doi:10.1177/1524839908325066
277. Cash, T., Desbrow, B., Leveritt, M., & Ball, L. (2014). Utilization and preference of nutrition information sources in Australia. *Health Expectations*, 18(6), 2288-2295. doi:10.1111/hex.12198
278. Brawley, L. R., & Latimer, A. E. (2007). Physical activity guides for Canadians: Messaging strategies, realistic expectations for change, and evaluation. *Applied Physiology, Nutrition, and Metabolism*, 32(S2E), S170-184. doi:10.1139/h07-105
279. Geiger, C. J. (2001). Communicating dietary guidelines for Americans: Room for improvement. *Journal of the American Dietetic Association*, 101(7), 793-797. doi:10.1016/s0002-8223(01)00197-3
280. Love, P., Maunder, E., Green, M., Ross, F., & Smale-Lovely, J. (2001). South African food-based dietary guidelines: Testing of the preliminary guidelines among women in KwaZulu-Natal and the Western Cape. *South African Journal of Clinical Nutrition*, 14(1), 9-19.
281. Boylan, S., Louie, J. C., & Gill, T. P. (2012). Consumer response to healthy eating, physical activity and weight-related recommendations: a systematic review. *Obesity Reviews*, 13(7), 606-617. doi:10.1111/j.1467-789X.2012.00989.x
282. Gittelsohn, J., Steckler, A., Johnson, C. C., Pratt, C., Grieser, M., Pickrel, J., . . . Staten, L. K. (2006). Formative research in school and community-based health programs and studies: "State of the art" and the taag approach. *Health Education and Behavior*, 33(1), 25-39. doi:10.1177/1090198105282412
283. Johnston, B. C., Kanters, S., Bandayrel, K., Wu, P., Naji, F., Siemieniuk, R. A., . . . Mills, E. J. (2014). Comparison of weight loss among named diet programs in overweight and obese adults: A meta-analysis. *Journal of the American Medical Association*, 312(9), 923-933. doi:10.1001/jama.2014.10397
284. Amazon. (2015). *Amazon advertising*. Retrieved 30 December, 2015, from <https://advertising.amazon.com/>
285. Berry, R. (2006). Will the ipod kill the radio star? Profiling podcasting as radio. *Convergence: The International Journal of Research into New Media Technologies*, 12(2), 143-162. doi:10.1177/1354856506066522
286. Apple Inc. (2015). Podcasts: Fitness and nutrition top charts: Apple Inc.
287. Amazon.com Inc. (2015). *Amazon best sellers: Health, fitness & dieting*. Retrieved 06 May, 2015, from http://www.amazon.com/Best-Sellers-Books-Health-Fitness-Dieting/zgbs/books/10/ref=zg_bs_nav_b_1_b

288. Apple Inc. (2014). *Podcasts, health: Fitness and nutrition*. Retrieved 28 May, 2014, from <https://itunes.apple.com/us/genre/podcasts-health-fitness-nutrition/id1417?mt=2>
289. Katz, D. L., & Meller, S. (2014). Can we say what diet is best for health? *Annual Review of Public Health*, 35, 83-103. doi:10.1146/annurev-publhealth-032013-182351
290. Kravitz, L. (2014). ACSM information on high-intensity interval training. Retrieved from <https://www.acsm.org/docs/brochures/high-intensity-interval-training.pdf>
291. Esco, M. (2013). ACSM information on resistance training for health and fitness. Retrieved from <https://www.acsm.org/docs/brochures/resistance-training.pdf>
292. Pollock, M. L. P., Gaesser, G. A., Butcher, J. D., Despres, J.-P., Dishman, R. K., Franklin, B. A., & Garber, C. E. (1998). ACSM position stand: The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Medicine and Science in Sports and Exercise*, 30(6), 975-991.
293. Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., . . . Swain, D. P. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine and Science in Sports and Exercise*, 43(7).
294. Chatham, J. (2013). *Paleo for beginners: Essentials to get started*. California: Rockridge Press.
295. Davis, W. (2011). *Wheat belly*. New York: Rodale Inc.
296. Somers, S. (2015). *Tox-sick: from toxic to not sick*. New York: Harmony Books.
297. Gedgaudas, N. T. (2010, 07 May 2015). *Primal body primal mind radio* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/primal-body-primal-mind-radio/id385416862?mt=2>
298. Bell, M., Farr, M., & McDonald, J. (2013, 07 May 2015). *Mark Bell's PowerCast* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/mark-bells-powercast/id710541646?mt=2>
299. Boyle, M. (2007, 08 May 2015). *The strength coach podcast* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/the-strength-coach-podcast/id267200514?mt=2>
300. DeFranco, J. (2015, 08 May 2015). *Joe DeFranco's industrial strength show* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/joe-defrancos-industrial-strength/id973579797?mt=2>
301. Pomroy, H. (2012). *The fast metabolism diet: Eat more food and lose more weight*. New York: Harmony Books.
302. Ballantyne, C. (2008, 08 May 2015). *The turbulence training podcast* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/turbulence-training-podcast/id300308945?mt=2>
303. Precision Nutrition. (2015, 07 May 2015). *Eat, move and live better* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/eat-move-and-live-better/id982915593?mt=2>
304. Turley, R., Brigman, H., & Ainslie, J. (2010, 07 May 2015). *Fat to fit radio* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/fat-2-fit-radio/id266422526?mt=2>
305. Hartwig, D., & Hartwig, M. (2012). *It starts with food: Discover the whole30 and change your life in unexpected ways*. USA: Victory Belt Publishing.

306. Hartwig, M., & Hartwig, D. (2015). *The Whole 30: The 30 day guide to total health and food freedom*. New York: Houghton Mifflin Harcourt Publishing Company.
307. Joulwan, M. (2013). *Well fed*. Austin: Smudge Publishing., LLC.
308. Lennon, D. (2014, 07 May 2015). *Sigma nutrition radio* [Podcast]. Retrieved from <https://itunes.apple.com/id/podcast/sigma-nutrition-radio-health/id857888327?mt=2>
309. Reinagel, M. (2009, 06 May 2015). *The nutrition divas quick and dirty tips for eating well and feeling fabulous* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/nutrition-divas-quick-dirty/id289338154?mt=2>
310. Koskella, K., & Bertrand, W. (2009, 08 May 2015). *Healthy mind fit body* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/healthy-mind-fit-body/id332309038?mt=2>
311. Patrick-Goudreau, C. (2006, 07 May 2015). *Food for thought: The joys and benefits of living compassionately and healthfully* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/food-for-thought-joys-benefits/id147907532?mt=2>
312. Barbell Shrugged. (2012, 07 May 2015). *Barbell Shrugged: Talking, training and interviews with CrossFit games athletes* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/barbell-shrugged-talking-training/id509969439?mt=2>
313. Spencer, A., & Spencer, T. (2014, 12 May 2015). *Marathon training academy* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/marathon-training-academy/id359208879?mt=2>
314. Asprey, D. (2014). *The bulletproof diet: Lose up to a pound a day, reclaim energy and focus, upgrade your life* New York: Rodale Inc.
315. McGraw, P. (2014). *The 20/20 diet: Turn your weight loss vision into reality*. California: Bird St Books.
316. Perlmutter, D. (2013). *Grain brain: The surprising truth about wheat, carbs, and sugar: Your brain's silent killers*. New York: Little, Brown and Company.
317. Perlmutter, D. (2015). *Brain maker: The power of gut microbes to heal and protect your brain for life*. London: Hodder and Stoughton Ltd.
318. Smith, J. (2014). *10-day green smoothie cleanse*. New York: Atria Paperback.
319. Fragoso, S. (2011, 08 May 2015). *Everyday paleo: Paleo talk* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/everyday-paleo-paleo-talk/id414525160?mt=2>
320. Greenfield, B. (2014, 06 May 2015). *Get-fit guys quick and dirty tips to slim down and shape up* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/get-fit-guys-quick-dirty-tips/id371750376?mt=2>
321. Jackson, D. (2012, 08 May 2015). *Jillian Michael's fan podcast* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/jillian-michaels-fan-podcast/id356128530?mt=2>
322. Larrabee, K. (2009, 07 May 2015). *The FitCast* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/fitcast-fitness-nutrition/id151651969?mt=2>
323. Moore, J. (2013, 07 May 2015). *The livin' la vida low-carb show with Jimmy Moore* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/livin-la-vida-low-carb-show/id324601605?mt=2>

324. Sanfilippo, D., & Wolfe, L. (2011, 07 May 2015). *Balanced bites: modern paleo living with Diane Sanfilippo & Liz Wolfe* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/balanced-bites-modern-paleo/id461802297?mt=2>
325. Scott, K., & Dawn, K. (2015). *Tone it up: 28 days to fit, fierce, and fabulous* New York: Rodale Inc.
326. James, A. (2012, 12 May 2015). *The fat-burning man show by Abel James. Paleo nutrition, Ancestral Health, and primal fitness* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/fat-burning-man-show-by-abel/id501575043?mt=2>
327. Langolf, K. (2014, 12 May 2015). *Fit girl: Your guide to getting into shape* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/fit-girl-your-guide-to-getting/id258592484?mt=2>
328. Michaels, J. (2011, 06 May 2015). *The Jillian Michaels show* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/the-jillian-michaels-show/id418368811?mt=2>
329. Roll, R. (2014, 07 May 2015). *The Rich Roll podcast* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/the-rich-roll-podcast/id582272991?mt=2>
330. The Wellness Couch. (2011, 06 May 2015). *The wellness guys show* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/the-wellness-guys-show/id451152183?mt=2>
331. Vonhogen, R., & Ravenscraft, C. J. (2010, 06 May 2015). *Losing it with Jillian: A fan based podcast* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/losing-it-jillian-fan-based/id377613186?mt=2>
332. The Wellness Couch. (2012, 06 May 2015). *Up for a chat* [Podcast]. Retrieved from <https://itunes.apple.com/au/podcast/up-for-a-chat/id584063992?mt=2>
333. Rosenthal, J. (2015). *The power of primary food: Nourishment beyond the plate*. New York: Intergrative Nutrition Publishing.
334. Borges, M. (2015). *The 22-day revolution: The plant-based program that will transform your body, reset your habits, and change your life*. New York: Penguin Group.
335. Buettner, D. (2015). *The blue zones solution: Eating and living like the world's healthiest people*. Washington: National Geographic Society.
336. Freer, A. (2015). *Eat. Nourish. Glow.: 10 easy steps for losing weight, looking younger & feeling healthier*. London: Harper Collins Publishers.
337. Fuhrman, J. (2011). *Eat to live: The amazing nutrient-rich program for fast and sustained weight loss* (2 ed.). New York: Little, Brown and Company.
338. Gottfried, S. (2015). *The hormone reset diet: Heal your metabolism to lose up to 15 pounds in 21 days*. New York: Harper Collins Publishers.
339. Hyman, M. (2014). *The blood sugar solution 10-day detox diet: Activate your body's natural ability to burn fat and lose weight fast* New York: Little, Brown and Company.
340. Sanfilippo, D. (2012). *Practical paleo: A customized approach to health and a whole-foods lifestyle*. USA: Victory Belt Publishing.
341. Asprey, D. (2011, 06 May 2015). *Bulletproof radio* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/bulletproof-radio/id451295014?mt=2>

342. Croxton, S. (2010, 07 May 2015). *Underground wellness radio* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/underground-wellness-radio/id296766401?mt=2>
343. Eyles, B. J. (2010). *Fitness behaviour* [Podcast]. Retrieved from <https://itunes.apple.com/qa/podcast/fitness-behavior/id391411172?mt=2>
344. Greenfield, B. (2014, 07 May 2015). *Ben Greenfield fitness: Fitness, fat loss and performance advice* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/ben-greenfield-fitness-fitness/id283908977?mt=2>
345. Hinish, R., & Alberg, B. (2009, 07 May 2015). *Cut the fat weight loss blog, weight loss podcast, weight loss blog, fat loss program, paleo, weight loss motivation, how* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/cut-fat-weight-loss-blog-weight/id323397049?mt=2>
346. Jackson, D. (2014, 08 May 2015). *Logical weight loss* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/logical-weight-loss/id268178375?mt=2>
347. Sissons, M. (2015, 07 May 2015). *The Primal Blueprint podcast* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/the-primal-blueprint-podcast/id789935889?mt=2>
348. Virgin, J. (2014, 08 May 2015). *The Virgin diet lifestyle show* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/virgin-diet-lifestyle-show/id911502027?mt=2>
349. Wolf, R. (2009, 06 May 2015). *The paleo solution podcast: Paleo, diet, fitness, and health* [Podcast]. Retrieved from <https://itunes.apple.com/nz/podcast/robb-wolf-paleo-solution-podcast/id340221970?mt=2>
350. David, M., & Rosen, E. (2015, 06 May 2015). *Psychology of eating* [Podcast]. Retrieved from <https://itunes.apple.com/us/podcast/psychology-of-eating/id987724897?mt=2>
351. Knight, C. (2012). "An alliance with Mother Nature" : Natural food, health, and morality in low-carbohydrate diet books. *Food and Foodways*, 20(2), 102-122. doi:10.1080/07409710.2012.680352
352. Jallinoja, P., Niva, M., Helakorpi, S., & Kahma, N. (2014). Food choices, perceptions of healthiness, and eating motives of self-identified followers of a low-carbohydrate diet. *Food and Nutrition Research* 58, 23552. doi:10.3402/fnr.v58.23552
353. Feinman, R. D., Vernon, M. C., & Westman, E. C. (2006). Low carbohydrate diets in family practice: what can we learn from an internet-based support group. *Nutrition Journal*, 5(26). doi:10.1186/1475-2891-5-26
354. Marquis-Gravel, G., Hayami, D., Juneau, M., Nigam, A., Guilbeault, V., Latour, É., & Gayda, M. (2015). Intensive lifestyle intervention including high-intensity interval training program improves insulin resistance and fasting plasma glucose in obese patients. *Preventive Medicine Reports*, 2, 314–318. doi:10.1016/j.pmedr.2015.04.015
355. Rakobowchuk, M., Tanguay, S., Burgomaster, K. A., Howarth, K. R., Gibala, M. J., & MacDonald, M. J. (2008). Sprint interval and traditional endurance training induce similar improvements in peripheral arterial stiffness and flow-mediated dilation in healthy humans. *The American Journal of Physiology: Regulatory, Integrative and Comparative Physiology*, 295, R236–R242. doi:10.1152/ajpregu.00069.2008.
356. Bartlett, J. D., Close, G. L., MacLaren, D. P., Gregson, W., Drust, B., & Morton, J. P. (2011). High-intensity interval running is perceived to be more enjoyable than moderate-intensity continuous exercise: Implications for exercise adherence. *Journal of Sport Sciences*, 29(6), 547-553. doi:10.1080/02640414.2010.545427

357. Beverly, E. A., Miller, C. K., & Wray, L. A. (2008). Spousal support and food-related behavior change in middle-aged and older adults living with type 2 diabetes. *Health Education and Behavior*, 35(5), 707-720. doi:10.1177/1090198107299787
358. Falba, T. A., & Sindelar, J. L. (2008). Spousal concordance in health behavior change. *Health Services Research*, 43(1), 96-116. doi:10.1111/j.1475-6773.2007.00754.x
359. Gilbert, D., & Waltz, J. (2010). Mindfulness and health behaviors. *Mindfulness*, 1(4), 227-234. doi:10.1007/s12671-010-0032-3
360. Roberts, K. C., & Danoff-Burg, S. (2010). Mindfulness and health behaviors: Is paying attention good for you? *Journal of American College Health*, 59(3), 165-173. doi:10.1080/07448481.2010.484452
361. Muhajarine, N., Labonte, R., & Winquist, B. D. (2012). The Canadian Index of Wellbeing: Key findings from the healthy populations domain. *Canadian Journal of Public Health*, 103(5), e342-347.
362. Glasgow, R. E., Goldstein, M. G., Ockene, J. K., & Pronk, N. P. (2004). Translating what we have learned into practice. Principles and hypotheses for interventions addressing multiple behaviors in primary care. *American Journal of Preventive Medicine*, 27(S2), 88-101. doi:10.1016/j.amepre.2004.04.019
363. Gielen, A., McDonald, E., Gary, T., & L, B. (2008). Using the precede-proceed model to apply health behavior theories. In K. Glanz, B. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice* (4 ed.). San Francisco: Jossey-Bass.
364. Alfonso, V. C., Allison, D. B., Rader, D. E., & Gorman, B. S. (1996). The extended satisfaction with life scale: Development and psychometric properties. *Social Indicators Research*, 38(3), 275-301. doi:10.1007/bf00292049
365. Grigsby-Toussaint, D. S., Turi, K. N., Krupa, M., Williams, N. J., Pandi-Perumal, S. R., & Jean-Louis, G. (2015). Sleep insufficiency and the natural environment: Results from the US behavioral risk factor surveillance system survey. *Preventive Medicine*, 78, 78-84. doi:10.1016/j.ypmed.2015.07.011
366. Hone, L. (2015). *Understanding and measuring wellbeing*. Auckland University of Technology, Auckland.
367. Morrison, L., Moss-Morris, R., Michie, S., & Yardley, L. (2014). Optimizing engagement with internet-based health behaviour change interventions: Comparison of self-assessment with and without tailored feedback using a mixed methods approach. *British Journal of Health Psychology*, 19(4), 839-855. doi:10.1111/bjhp.12083
368. Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological Bulletin*, 133(4), 673-693. doi:10.1037/0033-2909.133.4.673
369. Johnson, S. S., Paiva, A. L., Cummins, C. O., Johnson, J. L., Dymont, S. J., Wright, J. A., . . . Sherman, K. (2008). Transtheoretical model-based multiple behavior intervention for weight management: Effectiveness on a population basis. *Preventive Medicine*, 46(3), 238-246. doi:10.1016/j.ypmed.2007.09.010
370. Prochaska, J. O., Evers, K. E., Castle, P. H., Johnson, J. L., Prochaska, J. M., Rula, E. Y., . . . Pope, J. E. (2012). Enhancing multiple domains of well-being by decreasing multiple health risk behaviors: A randomized clinical trial. *Population Health Management*, 15(5), 276-286. doi:10.1089/pop.2011.0060
371. O'Cathain, A., Hodginott, P., Lewin, S., Thomas, K. J., Young, B., Adamson, J., . . . Donovan, J. L. (2015). Maximising the impact of qualitative research in feasibility

studies for randomised controlled trials: guidance for researchers. *Pilot and Feasibility Studies*, 1(1). doi:10.1186/s40814-015-0026-y

372. McNeill, L. H., Kreuter, M. W., & Subramanian, S. V. (2006). Social environment and physical activity: A review of concepts and evidence. *Social Science and Medicine*, 63(4), 1011-1022. doi:10.1016/j.socscimed.2006.03.012
373. Hill, J. O. (2009). Can a small-changes approach help address the obesity epidemic? A report of the Joint Task Force of the American Society for Nutrition, Institute of Food Technologists, and International Food Information Council. *American Journal of Clinical Nutrition*, 89(2), 477-484. doi:10.3945/ajcn.2008.26566
374. Schulz, D. N., Kremers, S. P., & De Vries, H. (2015). Tailored ehealth lifestyle promotion: Which behavioral modules do users prefer? *Journal of Health Communication*, 20(6), 663-672. doi:10.1080/10810730.2015.1012243
375. Novick, G. (2008). Is there a bias against telephone interviews in qualitative research? *Research in Nursing and Health*, 31(4), 391-398. doi:10.1002/nur.20259
376. Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-1288. doi:10.1177/1049732305276687
377. Cleland, V., & Ball, K. (2013). What might work? Exploring the perceived feasibility of strategies to promote physical activity among women living in socioeconomically disadvantaged neighbourhoods. *Health Education Research*, 28(2), 205-219. doi:10.1093/her/cys097
378. Mohr, D., Cuijpers, P., & Lehman, K. (2011). Supportive accountability: A model for providing human support to enhance adherence to ehealth interventions. *Journal of Medical Internet Research*, 13(1). doi:10.2196/jmir.1602
379. Napolitano, M. A., Hayes, S., Bennett, G. G., Ives, A. K., & Foster, G. D. (2012). Using facebook and text messaging to deliver a weight loss program to college students. *Obesity*, 21(1), 25-31. doi:10.1002/oby.20232
380. Laranjo, L., Arguel, A., Neves, A. L., Gallagher, A. M., Kaplan, R., Mortimer, N., . . . Lau, A. Y. (2015). The influence of social networking sites on health behavior change: a systematic review and meta-analysis. *Journal of the American Medical Informatics Association*, 22(1), 243-256. doi:10.1136/amiajnl-2014-002841
381. Korda, H., & Itani, Z. (2013). Harnessing social media for health promotion and behavior change. *Health Promotion Practice*, 14(1), 15-23. doi:10.1177/1524839911405850
382. Statistics New Zealand. (2015). *Who are our supportive friends*. Retrieved 06 March, 2016, from www.stats.govt.nz/browse_for_stats/people_and_communities/Well-being/social-connectedness/social-networks/supportive-friends.aspx
383. Borra, S., Kelly, L., Tuttle, M., & Neville, K. (2001). Developing actionable dietary guidance messages: Dietary fat as a case study. *Journal of the American Dietetic Association*, 101(6), 678-684. doi:10.1016/S0002-8223(01)00170-5
384. Glasgow, R. E., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *American Journal of Public Health*, 89(9), 1322-1327. doi:10.2105/AJPH.89.9.1322

Appendices

Appendix A. Associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults

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Associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults

Kate B. Prendergast*, Grant M. Schofield and Lisa M. Mackay

Abstract

Background: In positive psychology optimal wellbeing is considered a broad, multi-dimensional construct encompassing both feelings and functioning. Yet, this notion of wellbeing has not been translated into public health. The purpose of this study is to integrate public health and positive psychology to determine associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults.

Methods: A web-based survey design was employed to collect data. Participants reported on their wellbeing and lifestyle behaviours including nutrition, exercise, sedentary behaviour, and sleep. Optimal wellbeing was calculated using a multi-dimensional scale designed to mirror the internationally recognised diagnostic criteria for mental disorders. Binary logistic regression was used to calculate associations between 10 lifestyle behaviours and optimal wellbeing.

Results: Of the total sample ($n = 9514$), 24 % met the criteria for optimal wellbeing. Compared to reference groups, the association with optimal wellbeing was greater for those who reported exercising ≥ 7 times/week (odds ratio: 1.61, 95 % confidence interval: 1.22–2.13, $p < 0.01$) and sitting “almost none of the time” (1.87, 1.01–3.29, $p < 0.01$). Optimal wellbeing was lower for those reporting restless sleep “almost all of the time” (0.24, 95 % CI: 0.17–0.32 $p < 0.01$) and consuming sugary drinks 5–6 times/week (0.73, 95 % CI: 0.53–0.95, $p < 0.05$).

Conclusions: Public health and positive psychology were integrated to provide support for a relationship between lifestyle behaviours and a multi-dimensional measure of optimal wellbeing. It is likely this relationship between lifestyle behaviours and optimal wellbeing is bidirectional giving rise to the debate that holistic approaches are needed to promote positive health.

Keywords: Positive psychology, Population survey, Positive health, Physical activity, Nutrition, Sleep

Background

In 1946 the World Health Organization defined health as “a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity” [1]. From this definition the notion of positive health, where health is considered beyond the absence of disease, emerged [2–4]. However, this concept of positive health remains somewhat elusive [2] as epidemiological work and public health guidelines continue to focus on preventing and restoring negative functioning rather than promoting positive health. In contrast to understanding

pathology, far less is known about the behaviours and characteristics associated with positive health and optimal wellbeing.

Recognition that a fundamental shift was needed to study wellbeing in its own right has led to the emergence of the positive psychology field [5, 6]. Within positive psychology a broader, more complex notion of wellbeing has emerged [7–10]. Optimal wellbeing—or flourishing as it is also referred—is considered a multi-dimensional construct incorporating both hedonic (e.g. positive emotion, life satisfaction, and happiness) and eudaimonic (e.g. meaning and purpose, positive relationships, and engagement) aspects of wellbeing [5, 8, 10, 11]. There is now agreement that multi-dimensional

* Correspondence: kate.prendergast@auct.ac.nz
Auckland University of Technology, Private Bag 92008, Auckland 1142, New Zealand



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measures of optimal wellbeing, which take into account hedonic and eudaimonic aspects of wellbeing, should be used to determine and characterise those individuals with the highest levels of wellbeing [5, 10].

Only recently have multi-dimensional measures of optimal wellbeing emerged which can be used to categorically determine those with the highest levels of wellbeing [5, 8]. In the largest wellbeing study to date, Huppert and So developed and tested a categorical measure of optimal wellbeing using a representative sample of 43,000 individuals from 22 European countries [5]. This measure of optimal wellbeing was developed using a conceptual framework specifically designed to mirror the internationally agreed methodology used to diagnose mental disorders [5]. Through a systematic examination of the symptoms of common mental disorders, generalised anxiety (ICD-10) and depression (DSM-IV), ten features representing optimal mental health were identified: happiness, vitality, optimism, resilience, self-esteem, emotional stability, engagement, meaning, competence, and positive relationships. Factor analysis, inter-item correlations, and data distribution indicated that optimal wellbeing required the presence of three factors: positive emotion (comprising happiness); positive characteristics (vitality, optimism, resilience, self-esteem, emotional stability); and positive functioning (engagement, meaning, competence, positive relationships). To be classified as having optimal wellbeing individuals are required to meet the criteria for positive emotion, four out of five features of positive characteristics, and three out of four features of positive functioning. This method of classifying the presence of optimal wellbeing is similar to that used to classify major depressive disorders where the presence of most, but not all, features are required.

Positive psychologists recognise that there is a need to identify characteristics and behaviours which are associated with optimal wellbeing [5, 10]. Nonetheless, research thus far has been limited to examining socio-demographic factors such as age, gender, ethnicity, and household income [8, 12]. It does however, seem plausible that prudent lifestyle behaviours, such as healthy eating, adequate sleep, physical activity, avoiding tobacco, and constraining alcohol consumption, may be associated with optimal wellbeing. Whilst lifestyle behaviours have been extensively examined in public health, research investigating associations between lifestyle behaviours and wellbeing have typically relied on single item measures of life satisfaction or happiness [13–15]. However, findings from previous studies show these single item measures only have small to moderate correlations with multi-dimensional measures of optimal wellbeing [5].

At an epidemiological level, an integrative approach to understanding associations between lifestyle behaviours and optimal wellbeing is needed. If associated, promoting

lifestyle behaviours may provide an opportunity for increasing wellbeing, or vice versa. Identifying lifestyle behaviours that are associated with optimal wellbeing will provide a useful step in guiding future research and interventions aimed at promoting positive health. The purpose of this study is to integrate measures from public health and positive psychology to determine (1) the proportion of a large, demographically diverse sample of New Zealand adults meeting the criteria for optimal wellbeing and (2) associations between lifestyle behaviours and optimal wellbeing. This study will contribute to the limited research on lifestyle behaviours and multi-dimensional measures of optimal wellbeing.

Methods

Data for this cross-sectional study were obtained from the Sovereign Wellbeing Index (Round 1); a survey on the health and wellbeing of a large, demographically diverse sample of New Zealand adults [16]. A web-based survey design was employed to collect data during September and October, 2012. Ethical approval to conduct the study was granted by the Auckland University of Technology Ethics Committee on 23 August, 2012 (AUTC: 12/201).

The web-based survey design was chosen as it offered a number of advantages over traditional data collection modes (i.e. door-to-door or computer assisted telephone interviews). These advantages include the relative cost-effectiveness of the approach, the ability to overcome geographical constraints, and the minimisation of errors associated with data entry [17]. Recent reports indicate the proportion of New Zealand households with access to the internet (80 %) and landline telephones (85 %) is similar [18, 19].

Participants

A commercial market research company (TNS Global, New Zealand office) was contracted to administer the web-based survey. Participants were recruited from the SmileCity database; the largest commercially available database in New Zealand. The database comprises 247,675 active members recruited through both offline (51 %) and online (49 %) sources [20].

The target sample size for the current study was 10,000 participants. The sample size was determined partly by financial constraints, and partly to obtain a reasonable precision of estimates. Eligible individuals included SmileCity database members aged over 18 years who had not participated in a survey within the last 7-days. There were no further exclusion criteria.

Email invites—with a link to the survey—were sent to 38,439 individuals randomly selected from the 229,032 eligible individuals. The survey was open to potential participants for 7-days. No follow-up invites were sent

to individuals who did not complete the survey within the specified timeframe. All participants provided informed consent prior to entering the survey.

Variables

The web-based survey included 134 questions on well-being, health and lifestyle, and socio-demographics. To enable international and national comparisons, the well-being component primarily comprised questions drawn from the European Social Survey (Round 6) [21] whilst the health and lifestyle component comprised questions primarily from the New Zealand Health Survey (2006) [22]. Measures specific to the current study only are discussed in detail below.

Optimal wellbeing

Optimal wellbeing was treated as a binary variable. The ten items (refer to Table 1) to measure optimal wellbeing were drawn from the European Social Survey (Round 6) [21]. A modified version of Huppert and So's scale, reflecting changes made to two items between Rounds 3 and 6 of the European Social Survey, was used to calculate optimal wellbeing [5, 23, 24]. The two items which differed from the original scale were 'I love learning new things' and 'There are people in my life who really care about me'. These items were replaced with 'To what extent do you learn new things in your life?' and 'To what extent do you receive help and support from people you are close to when you need it?' respectively [23, 24]. Hone

et al. recently demonstrated moderate to strong agreement between the modified version of Huppert and So's measure and other measures of optimal wellbeing [24].

The ten items used to measure optimal wellbeing combined both hedonic (feelings) and eudaimonic (functioning) aspects of wellbeing [5]. The items were rated on 4-point to 11-point Likert scales. All items were phrased in a positive direction except for the item measuring resilience, which was reverse coded. Optimal wellbeing was determined as meeting the thresholds for positive emotion (*happiness* ≥ 8); and four out of five features of positive characteristics (*vitality* ≥ 3 , *optimism* ≥ 4 , *resilience* ≥ 4 , *self-esteem* ≥ 4 , *emotional stability* ≥ 2); and three out of four features of positive functioning (*engagement* ≥ 5 , *meaning* ≥ 4 , *competence* ≥ 4 , *positive relationships* ≥ 4) [5, 24]. Table 1 provides a summary of the constructs, features, items, and thresholds used to calculate optimal wellbeing.

Socio-demographic variables

Self-reported socio-demographic variables including gender, date of birth, ethnicity, and household income were collected as part of the web-based survey. In accordance with Statistics New Zealand's Statistical Standard for Ethnicity, respondents were provided with the option of selecting multiple ethnic response categories [25]. Responses were coded into three independent categories (European/Other, Maori/Pacific, and Asian) using Statistics New Zealand Level 1 prioritised ethnic classifications

Table 1 Constructs, features, items and thresholds used to calculate optimal wellbeing

Construct and features	Item (Likert scale; anchors)	Threshold
Positive emotion (required)		
• Happiness	Taking all things together, how happy would you say you are? 0–10; <i>extremely unhappy</i> – <i>extremely happy</i>	≥ 8
Positive characteristics (4 of 5 required)		
• Emotional stability	In the past week, I felt calm and peaceful? 1–4; <i>none or almost none of the time</i> – <i>all or almost all of the time</i>	≥ 2
• Vitality	During the past week, you had a lot of energy? 1–4; <i>none or almost none of the time</i> – <i>all or almost all</i>	≥ 3
• Optimism	I am always optimistic about my future? 1–5; <i>strongly disagree</i> – <i>strongly agree</i>	≥ 4
• Resilience	When things go wrong in my life it generally takes me a long time to get back to normal? 1–5; <i>strongly disagree</i> – <i>strongly agree</i> ; reverse score	≥ 4
• Self-esteem	In general, I feel very positive about myself? 1–5; <i>strongly disagree</i> – <i>strongly agree</i>	≥ 4
Positive functioning (3 of 4 required)		
• Engagement	To what extent do you learn new things in your life? 0–6; <i>not at all</i> – <i>a great deal</i>	≥ 5
• Competence	Most days I feel a sense of accomplishment from what I do? 1–5; <i>strongly disagree</i> – <i>strongly agree</i>	≥ 4
• Meaning	I generally feel that what I do in my life is valuable and worthwhile? 1–5; <i>strongly disagree</i> – <i>strongly agree</i>	≥ 4
• Positive relationships	To what extent do you receive help and support from people you are close to when you need it? 0–6; <i>not at all</i> – <i>completely</i>	≥ 4

To be classified as meeting the criteria for optimal wellbeing individuals must (1) meet the threshold for positive emotion; (2) meet the threshold for four out of five features of positive characteristics; and (3) meet the threshold for three out of four features of positive functioning

[25]. Date of birth was used to calculate age with the survey start date as the reference. Continuous age was recoded into 10-yearly groupings according to Statistics New Zealand's Statistical Standard for Age [26]. Finally, household income was stratified into tertiles to reflect low ($\leq \$40,000$), moderate ($\$40,000$ – $\$90,000$), and high ($\geq \$90,001$) incomes.

Lifestyle behaviours

Ten lifestyle behaviours were included in the analysis including breakfast consumption, sugary drink consumption, fruit intake, vegetable intake, smoking, alcohol consumption, exercise, sedentary behaviour, sleep quality, and body mass index (BMI).

Questions to measure breakfast consumption, sugary drink consumption, fruit intake, vegetable intake, smoking, and alcohol consumption were drawn from the New Zealand Health Survey (2006), an annual door-to-door survey conducted by the Ministry of Health [22]. Respondents were asked to indicate how many days during the past week they had breakfast (*never, 1–2 days, 3–4 days, 5–6 days, 7 days*); how often during the past week they drank sugary beverages (*I don't drink sugary drinks, less than once, 1–2 times, 3–4 times, 5–6 times, ≥ 7 times*); on average how many servings of fruit they had over the past week (*I don't eat fruit, < 1 serving/day, 1 serving/day, 2 servings/day, 3 servings/day, ≥ 4 servings/day*); and on average how many servings of vegetables they had over the past week (*I don't eat vegetables, < 1 serving/day, 1 serving/day, 2 servings/day, 3 servings/day, ≥ 4 servings/day*) [22]. For smoking, respondents were asked if they smoke cigarettes regularly (*yes, no*) [22]. Alcohol consumption was assessed by asking respondents to indicate how often they have a drink containing alcohol (*I don't drink alcohol, monthly or less, up to four times/month, up to three times/week, ≥ 4 times/week*) [22].

Exercise was measured using a single item exercise frequency question which asked participants to report how often during the past week they exercised (*I didn't exercise, 1–2 times, 3–4 times, 5–6 times, ≥ 7 times*) [14, 27]. Sedentary behaviour was measured using a single item sitting question [28]. Response options were adapted from their original format (*never, seldom, sometimes, often, always*) [28] to reflect the response scales used throughout the web-based survey (*none or almost none of the time, a little of the time, some of the time, most of the time, all or almost all of the time*).

Sleep quality was assessed using a question drawn from the European Social Survey (Round 6) Survey [29]. The question originates from the Center for Epidemiologic Studies Depression Scale [30] and has been used to measure restless sleep elsewhere [31, 32]. Respondents were asked to indicate how much of the time during the past week their sleep was restless (*none or almost none*

of the time, some of the time, most of the time, all or almost all of the time).

Body mass index was derived using self-reported height and weight measures and was calculated as $\text{weight}_{\text{kg}}/(\text{height}_{\text{m}}^2)$. World Health Organization thresholds were used to categorise BMI as: underweight (≤ 18.4), normal weight (18.5 – 24.9), overweight (25.0 – 29.9), and obese (≥ 30.0) [33].

With the exception of BMI, all lifestyle variables are reported as per their original response scales.

Data analysis

Optimal wellbeing was treated as the dependent variable. Participants' data were, therefore, only included in the final analyses if a response was provided for each of the ten items used to calculate optimal wellbeing. Binary logistic regression analysis was used to determine associations between both demographic factors and lifestyle behaviours and optimal wellbeing (IBM SPSS Statistics version 19 for Windows). Crude, partially adjusted (adjusted for age, gender, ethnicity, and household income), and fully adjusted (adjusted for all socio-demographic and lifestyle variables concurrently) odds ratios were calculated. Bootstrapped 95 % confidence intervals (CI) were calculated using 1000 samples. The alpha was set at 0.05 to determine statistical significance. Missing data for lifestyle behaviours and socio-demographic variables were excluded pairwise.

Results

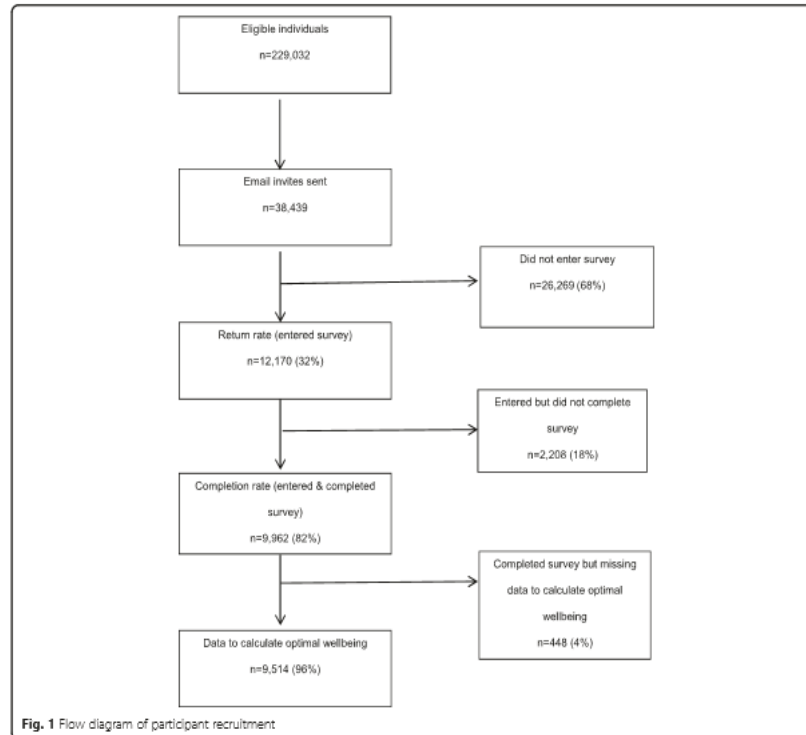
Participant characteristics

The return rate for the survey was 32 % ($n = 12,170$) and the completion rate was 82 % ($n = 9962$) (Fig. 1). Of those deemed to have completed the survey, data to calculate optimal wellbeing were available for 9514 (47 % male) participants. Sample characteristics for the current study are shown in Table 2.

The sample characteristics were compared to the estimated resident population in New Zealand during the June, 2012 to September, 2012 quarter [34]. Our sample was slightly over-represented by those in the lowest household income tertile (33 % vs. 32 %) and slightly under-represented by males (47 % vs. 49 %), and those aged 40–49 years (17 % vs. 19 %), 50–59 years (16 % vs. 18 %), and over 60 years (23 % vs. 26 %). Comparing the final sample characteristics to those that did not respond to the survey invite indicated non-respondents were over-represented by males (47 % vs. 51 %), those aged 18–29 years (26 % vs. 38 %), and those aged 30–39 years (18 % vs. 19 %).

Optimal wellbeing

In total, 24 % ($n = 3964$) of the sample met the criteria for optimal wellbeing (Table 3). Over half the sample



(54 %) met the criteria for positive functioning, whilst 41 % and 44 % met the criteria for positive emotions and positive characteristics, respectively (Table 3).

Lifestyle behaviours and optimal wellbeing

Table 2 shows the crude, partially adjusted (age, gender, ethnicity, and household income), and fully adjusted (all demographic and lifestyle variables) odds ratios and bootstrapped 95 % CIs for optimal wellbeing and each of the socio-demographic and lifestyle variables assessed.

Socio-demographic variables

No associations between gender and optimal wellbeing were observed.

The trend across the three models indicates the likelihood of achieving the criteria for optimal wellbeing increases with age. The fully adjusted odds ratios show those aged 70–79 years were significantly more likely to

report optimal levels of wellbeing compared to those aged less than 20 years (OR: 2.00, 95 % CI: 1.16–3.51, $p < 0.05$).

No association was observed between ethnicity and achieving the criteria for optimal wellbeing in the crude model. However, when adjusting for age, gender, and household income, Asian people and Maori/Pacific people were significantly more likely to meet the criteria for optimal levels of wellbeing compared to European/Other people. In the fully adjusted model the association between ethnicity and optimal wellbeing remained for Maori/Pacific people (1.52, 1.23–1.89, $p < 0.01$) but was negated for Asian people.

Household income was significantly associated with optimal wellbeing in each model. In the fully adjusted model those in the middle and highest income tertiles were 1.30 (1.10–1.56, $p < 0.01$) and 1.84 (1.55–2.23, $p < 0.01$) times more likely, respectively, to reach the criteria

Table 2 Sample characteristics and odds ratios for the relationship between lifestyle behaviours and optimal wellbeing (*n* = 9514)

	Total n (%)	Optimal wellbeing n (% 95 % CI)	Crude OR ^a (95 % CI ^b)	Partially ^a adjusted OR ^c (95 % CI ^b)	Fully ^a adjusted OR ^d (95 % CI ^b)
Gender					
Male	4478 (47)	1101 (25, 23–26)	1.00	1.00	1.00
Female	5035 (53)	1199 (24, 23–25)	0.96 (0.88–1.06)	1.10 (0.98–1.23)	1.02 (0.88–1.18)
Age, years					
< 20	221 (3)	41 (19, 13–24)	1.00	1.00	1.00
20–29	1856 (23)	359 (19, 18–21)	1.05 (0.75–1.56)	0.93 (0.60–1.59)	0.90 (0.55–1.50)
30–39	1472 (18)	305 (21, 19–23)	1.15 (0.82–1.75)	0.90 (0.57–1.53)	0.75 (0.46–1.27)
40–49	1413 (17)	303 (21, 19–24)	1.20 (0.85–1.82)	0.94 (0.59–1.62)	0.81 (0.50–1.42)
50–59	1326 (16)	336 (25, 23–28)	1.49 (1.06–2.21)*	1.23 (0.78–2.10)	0.98 (0.60–1.69)
60–69	1337 (16)	448 (34, 31–36)	2.21 (1.59–3.40)**	2.18 (1.40–3.69)**	1.43 (0.88–2.43)
70–79	495 (6)	198 (40, 36–44)	2.99 (2.03–4.39)**	3.36 (2.09–6.13)**	2.00 (1.16–3.51)*
≥ 80	54 (1)	17 (32, 19–44)	2.02 (0.94–3.92)*	1.91 (0.77–4.28)	1.19 (0.51–2.75)
Ethnicity					
European/Other	7093 (76)	1724 (24, 23–25)	1.00	1.00	1.00
Asian	1002 (11)	232 (23, 21–26)	0.94 (0.80–1.09)	1.26 (1.02–1.55)*	1.25 (0.97–1.59)
Māori/Pacific	1229 (13)	313 (26, 23–28)	1.06 (0.92–1.23)	1.20 (0.99–1.41)*	1.52 (1.23–1.89)**
Household income					
Low (≤ \$40,000)	2366 (33)	481 (20, 19–22)	1.00	1.00	1.00
Mid (\$40,001–\$90,000)	2510 (36)	582 (23, 22–25)	1.18 (1.04–1.36)*	1.46 (1.27–1.67)**	1.30 (1.10–1.56)**
High (≥ \$90,001)	2191 (31)	660 (30, 28–32)	1.69 (1.47–1.93)**	2.26 (1.93–2.61)**	1.84 (1.55–2.23)**
Restless sleep, how often past week					
None or almost none of the time	2182 (23)	754 (35, 33–37)	1.00	1.00	1.00
Sometimes	4397 (46)	1246 (28, 27–30)	0.75 (0.67–0.84)**	0.78 (0.68–0.89)**	0.83 (0.71–0.96)*
Most times	1915 (20)	217 (11, 10–13)	0.24 (0.20–0.29)**	0.27 (0.22–0.33)**	0.31 (0.24–0.39)**
All or almost all of the time	1009 (11)	84 (8, 7–10)	0.17 (0.13–0.22)**	0.20 (0.15–0.26)**	0.24 (0.17–0.32)**
Body mass index					
Normal weight	2660 (35)	645 (24, 23–26)	1.00	1.00	1.00
Underweight	148 (2)	28 (19, 13–25)	0.73 (0.46–1.08)	0.70 (0.39–1.14)	0.75 (0.37–1.30)
Overweight	2521 (33)	730 (29, 27–31)	1.27 (1.12–1.44)**	1.18 (1.01–1.38)*	1.24 (1.05–1.46)*
Obese	2375 (31)	491 (21, 19–22)	0.81 (0.71–0.93)**	0.75 (0.63–0.88)**	0.89 (0.74–1.07)
Alcohol, how often do you have a drink containing					
Up to 4 times/month	1707 (18)	450 (26, 24–28)	1.00	1.00	1.00
Never	2408 (26)	573 (24, 22–26)	0.87 (0.75–1.01)	0.83 (0.70–1.00)*	0.88 (0.71–1.08)
Monthly or less	2858 (31)	595 (21, 19–22)	0.73 (0.64–0.85)**	0.72 (0.61–0.85)**	0.76 (0.62–0.92)**
Up to 3 times/week	1273 (14)	342 (27, 24–29)	1.03 (0.86–1.22)	0.88 (0.71–1.06)	0.90 (0.72–1.11)
≥ 4 times/week	1088 (12)	300 (28, 25–30)	1.06 (0.89–1.27)	0.79 (0.65–0.98)*	0.87 (0.68–1.08)
Regular smoker					
Yes	1642 (17)	291 (18, 16–20)	1.00	1.00	1.00
No	7779 (83)	1997 (26, 25–27)	1.60 (1.40–1.85)**	1.44 (1.23–1.72)**	1.18 (0.98–1.45)
Exercise, how many times past week					
Don't exercise	3379 (38)	614 (18, 17–19)	1.00	1.00	1.00
1–2 times/week	2552 (28)	612 (24, 22–26)	1.42 (1.24–1.62)**	1.46 (1.23–1.69)**	1.21 (1.02–1.43)*
3–4 times/week	1874 (21)	535 (29, 27–31)	1.80 (1.58–1.62)**	1.81 (1.52–2.13)**	1.39 (1.13–1.69)**

Table 2 Sample characteristics and odds ratios for the relationship between lifestyle behaviours and optimal wellbeing (*n* = 9514) (Continued)

5–6 times/week	972 (11)	309 (32, 29–35)	2.10 (1.79–2.46)**	1.88 (1.56–2.29)**	1.37 (1.11–1.69)**
≥ 7 times/week	215 (2)	188 (37, 32–41)	2.59 (2.11–3.11)**	2.32 (1.78–3.10)**	1.61 (1.22–2.13)**
Sedentary levels, time spent sitting for the most part of each day past week					
All or almost all of the time	651 (7)	99 (15, 12–18)	1.00	1.00	1.00
None or almost none of the time	192 (2)	53 (28, 21–34)	2.13 (1.42–3.23)**	2.28 (1.38–3.72)**	1.87 (1.01–3.29)**
A little of the time	1263 (13)	363 (29, 26–31)	2.25 (1.77–2.96)**	1.91 (1.42–2.37)**	1.68 (1.20–2.49)**
Some of the time	4177 (44)	1169 (28, 27–29)	2.17 (1.72–2.78)**	1.88 (1.46–2.60)**	1.59 (1.18–2.26)**
Most of the time	3151 (33)	598 (19, 18–20)	1.31 (1.03–1.68)*	1.16 (0.91–1.62)	1.09 (0.79–1.57)
Vegetables, average servings per day over last week					
Don't eat vegetables	107 (1)	11 (10, 5–16)	1.00	1.00	1.00
< 1 serving/day	859 (9)	115 (13, 11–16)	1.35 (0.77–2.99)	1.51 (0.68–7.07)	1.43 (0.58–7.14)
1 servings/day	2327 (25)	496 (21, 20–23)	2.36 (1.39–5.38)*	2.42 (1.13–11.89)*	1.75 (0.75–8.44)
2 servings/day	2432 (26)	577 (24, 22–25)	2.71 (1.58–6.09)**	3.01 (1.44–14.30)*	2.06 (0.86–10.17)
3 servings/day	2045 (22)	579 (28, 26–30)	3.45 (2.03–7.87)**	3.52 (1.62–16.79)**	2.21 (0.92–10.84)
≥ 4 servings/day	1563 (17)	502 (32, 30–34)	4.13 (2.42–9.27)**	4.22 (1.97–19.63)**	2.31 (0.97–11.54)
Fruit, average servings/day over last week					
Don't eat fruit	323 (3)	42 (13, 9–17)	1.00	1.00	1.00
< 1 serving/day	1931 (21)	301 (16, 14–17)	1.24 (0.89–1.825)	1.07 (0.72–1.67)	0.88 (0.55–1.46)
1 servings/day	2826 (30)	661 (23, 22–25)	2.04 (1.50–2.89)**	1.68 (1.17–2.74)*	1.06 (0.66–1.78)
2 servings/day	2489 (27)	696 (28, 26–30)	2.60 (1.89–3.79)**	2.06 (1.43–3.27)**	1.13 (0.71–1.88)
3 servings/day	1134 (12)	356 (31, 29–34)	3.06 (2.21–4.54)**	2.38 (1.64–3.96)**	1.28 (0.78–2.19)
≥ 4 servings/day	642 (7)	226 (35, 32–39)	3.63 (2.60–5.49)**	2.59 (1.68–4.20)**	1.35 (0.80–2.35)
Breakfast, how many days over last week					
7 days/week	5255 (56)	1561 (30, 28–31)	1.00	1.00	1.00
Never	1060 (11)	153 (14, 12–17)	0.40 (0.33–0.47)**	0.50 (0.40–0.62)**	0.81 (0.62–1.08)
1–2 days/week	1116 (12)	178 (16, 14–18)	0.45 (0.37–0.53)**	0.54 (0.43–0.68)**	0.75 (0.58–0.93)*
3–4 days/week	943 (10)	196 (21, 18–23)	0.62 (0.52–0.73)**	0.80 (0.65–0.98)*	0.91 (0.71–1.17)
5–6 days/week	1020 (11)	200 (20, 17–22)	0.58 (0.49–0.67)**	0.60 (0.48–0.73)**	0.67 (0.52–0.84)**
Sugary drinks, how often over last week					
Don't drink sugary drinks	2545 (27)	784 (31, 29–33)	1.00	1.00	1.00
< 1 time/week	1516 (16)	389 (26, 23–28)	0.78 (0.68–0.90)**	0.83 (0.69–0.99)*	0.86 (0.70–1.06)
1–2 times/week	2340 (25)	534 (23, 21–25)	0.66 (0.58–0.75)**	0.77 (0.66–0.90)**	0.82 (0.67–1.00)
3–4 times/week	1366 (15)	283 (21, 19–23)	0.59 (0.51–0.68)**	0.72 (0.59–0.87)**	0.83 (0.66–1.03)
5–6 times/week	684 (7)	123 (18, 15–21)	0.49 (0.40–0.60)**	0.60 (0.46–0.78)**	0.73 (0.53–0.95)*
≥ 7 times/week	932 (10)	175 (19, 16–21)	0.52 (0.43–0.63)**	0.67 (0.54–0.85)**	0.92 (0.71–1.18)

p* < 0.05; *p* < 0.01; ¹odds ratio; ²bootstrapped 95 % confidence interval; ³adjusted for gender, age, ethnicity, income; ⁴adjusted for all demographic and lifestyle behaviours concurrently

for optimal wellbeing compared to those in the lowest income tertile.

Nutrition variables

The average number of servings of fruit and vegetables consumed each day were positively and significantly associated with optimal wellbeing in the crude and

partially adjusted models. However, these associations were negated in the fully adjusted model.

Sugary drink intake was inversely and significantly associated with optimal wellbeing in the crude and partially adjusted models. In the fully adjusted model consuming sugary drinks 5–6 times per week was associated with a decreased likelihood (0.73, 0.53–0.95, *p* < 0.05) of achieving the criteria for optimal wellbeing,

Table 3 Proportion of the sample meeting the criteria for optimal wellbeing (n = 9514)

Wellbeing features	n	%
Optimal wellbeing	2303	24
Positive emotion	3917	41
Positive characteristics (total meeting 4 of 5 features)	4219	44
Vitality	3712	39
Optimism	5918	62
Resilience	4357	46
Self-esteem	6431	68
Emotional stability	8414	88
Positive functioning (total meeting 3 of 4 features)	5103	54
Meaning	6801	72
Positive relationships	6488	68
Engagement	4210	44
Competence	5499	58

Optimal wellbeing was calculated as meeting thresholds for a) positive emotion and; b) four out of five features of positive characteristics – vitality, optimism, resilience, self-esteem, emotional stability and; c) three out of four features of positive functioning – meaning, positive relationships, engagement, competence [5, 24]

compared to those who reported that they do not consume sugary drinks.

Compared to those that reported eating breakfast daily, eating breakfast 1–2 days per week (0.75, 0.58–0.93, $p < 0.05$) and 5–6 days per week (0.67, 0.52–0.84, $p < 0.01$) were associated with a decreased likelihood of being in the optimal wellbeing group.

The crude and partially adjusted models showed obese people were significantly less likely to have optimal levels of wellbeing compared to normal weight people, however, this association was negated in the fully adjusted model. Conversely, overweight people were significantly more likely to have optimal levels of wellbeing compared to normal weight people in all three models.

Health risk behaviours

Compared to smokers, being a non-smoker was associated with an increased likelihood of reaching the criteria for optimal wellbeing in the crude (1.60, 1.40–1.85, $p < 0.01$) and partially adjusted (1.44, 1.23–1.72, $p < 0.01$) models; however, these associations were negated in the fully adjusted model.

Compared to those that consume alcohol up to four times per month, drinking alcohol monthly or less was significantly associated with a decreased likelihood of being in the optimal wellbeing group in the crude (0.73, 0.64–0.85, $p < 0.01$), partially adjusted (0.72, 0.61–0.85, $p < 0.01$), and fully adjusted (0.76, 0.62–0.92, $p < 0.01$) models.

Exercise and sedentary behaviour

Exercise was positively and significantly associated with achieving the criteria for optimal wellbeing in all three models. Compared to those who reported doing no exercise, exercising seven or more times per week was associated with a 1.61 (1.22–2.13, $p < 0.01$) increased likelihood of being in the optimal wellbeing group in the fully adjusted model.

An inverse relationship between sedentary levels and optimal wellbeing was observed in all three models; decreases in sedentary behaviour were associated with an increased likelihood of meeting the criteria for optimal wellbeing. In the fully adjusted model, those who reported sitting none or almost none of the time during the past week were 1.87 (1.01–3.29, $p < 0.01$) times more likely to meet the criteria for optimal wellbeing.

Sleep

In all three models restless sleep was negatively associated with optimal wellbeing. In the fully adjusted model, having restless sleep all or almost all of the time was associated with a significantly decreased (0.24, 0.17–0.32, $p < 0.01$) likelihood of being in the optimal wellbeing group compared to those reporting restless sleep none or almost none of the time.

Discussion

To develop positive health and wellbeing interventions a better understanding of the characteristics and behaviours associated with optimal wellbeing is needed. In the present study a multi-dimensional measure of optimal wellbeing was used to classify those with the highest levels of wellbeing in a large and diverse sample of New Zealand adults. Our findings show 24 % of the sample met the criteria for optimal wellbeing. The second aim of the study was to integrate measures from public health and positive psychology to determine lifestyle behaviours associated with a multi-dimensional measure of optimal wellbeing. In the fully adjusted model, optimal wellbeing was positively associated with exercise, inversely associated with sedentary behaviour, and negatively associated with sleep.

In previous research on life satisfaction, New Zealand ranks similar or just below the highest ranked Scandinavian nations [35]. Comparing our findings to the largest study of optimal wellbeing in Europe suggests that proportion of New Zealanders meeting the criteria for optimal wellbeing in the current sample is comparable to Sweden (24 %; ranked 7 of 22) [5]. Nevertheless, the 24 % reported in our sample is substantially lower than the prevalence of optimal wellbeing in the highest ranked country, Denmark (41 %) [5]. Our data indicates that individuals in our sample who were more likely to achieve the criteria for optimal wellbeing were those with higher

household incomes and those aged 70–79 years. It was also interesting to observe, that in contrast to previous research reporting lower levels of satisfaction with life among Maori and Pacific people [36, 37], we found no evidence to support this relationship. In contrast, we found those who identified as Maori or Pacific were more likely to achieve optimal levels of wellbeing compared to those who identified as European. Whilst these ethnic differences in optimal wellbeing warrant further investigation, the discrepancy between our research and others may in part be explained by the wellbeing measures used. We used a broader criteria to measure optimal wellbeing which takes into account dimensions such as positive relationships and meaning and purpose. Maori and Pacific people may have scored higher on these dimensions due to the cultural value placed on philosophies such as *whanaungatanga* and *hauora* [38]. For example, *whanaungatanga* emphasises the family and community whilst *hauora* emphasises physical, mental and emotional, social, and spiritual wellbeing approaches to health [38].

In the present study, we extend previous research on life satisfaction [13] and happiness [14] to show for the first time that sleep, exercise, and sedentary behaviour are independently associated with a multi-dimensional measure of optimal wellbeing. Although exercise, and to a lesser extent minimising sedentary behaviour, are important public health priorities, sleep is often overlooked. There is now increasing evidence to show that sleep is associated with health outcomes [39]. Our findings also indicate that reporting restless sleep almost all of the time was associated with 0.24-fold decreased likelihood of meeting the criteria for optimal wellbeing, compared with those reporting restless sleep almost none of the time. This is concerning as there is accumulating evidence to suggest that there has been a global reduction in sleep [40, 41]. Given the potential implications for health and wellbeing increased efforts should be made to raise awareness of strategies to improve sleep quality.

To a lesser degree, associations between optimal wellbeing and breakfast consumption, sugary drink intake, BMI, and alcohol consumption were also observed in the current study. Similar associations between breakfast consumption and happiness have been observed previously [14]. In our study we found that compared to those who drink alcohol up to four times per month, drinking alcohol monthly or less was associated with a 0.76-fold decreased likelihood of achieving the criteria for optimal wellbeing. Though not significant Piqueras et al. [14] reported a similar trend; compared to those that never drink those who reported drinking were more likely to be classified as happy (OR 1.07; $p = 0.52$). One possible explanation for this somewhat unexpected

finding is that those occasionally drinking may be doing so in social environments thereby benefiting from social interaction and enhanced positive relationships. Finally, consuming sugary drinks 5–6 times per week was associated with a 0.73-fold decreased likelihood of achieving the criteria for optimal wellbeing. Limiting sugar is, therefore, likely to have implications from both a health and wellbeing perspective.

The relationship between lifestyle behaviours and optimal wellbeing is complex and likely to be bidirectional. On the one hand, if individuals feel optimistic, energetic, confident, and supported they are probably more likely to engage in positive lifestyle behaviours [42]. Alternatively, there is also evidence to support the claim that optimal wellbeing is enhanced by healthy lifestyle behaviours [43]. Specifically, experimental research in human and animal studies shows that engaging in healthy behaviours such as exercise [44], healthy eating [45, 46], and quality sleep [47] reduces inflammation and enhances BDNF. Reducing inflammation and enhancing BDNF expression promotes neuroplasticity which is important for dimensions of optimal wellbeing related to creativity, exploration, and curiosity [43].

It is pertinent to note that three quarters of the sample in the current study were not meeting the criteria for optimal wellbeing. It is therefore evident that further efforts need to be made promote and increase optimal wellbeing. Whilst the causal relationship between lifestyle behaviours and optimal wellbeing cannot be determined from our data, existing evidence supports the claim that the relationship is likely to be bidirectional. Our findings, together with the literature, provide support for holistic interventions which integrate the promotion of lifestyle behaviours and the dimensions underpinning optimal wellbeing (e.g. relationships, self-esteem, and resilience). Our research shows the lifestyle variables which should be targeted in such interventions include sleep, exercise, and sedentary behaviour, and to a lesser degree sugary drink consumption and breakfast intake.

Limitations

The findings from this study should be considered in light of the limitations. Firstly, although the web-based survey design offered a number of advantages, the response rate was low (32 %). Comparisons to the estimated resident population during the September 2012 quarter indicate our sample was slightly over-represented by younger adults and slightly under-represented by those aged over 60 years. Secondly, the current study relied on self-reported lifestyle behaviours, rather than observational measures. There is therefore a possibility that individuals were subject to social desirability bias. Finally, the cross-sectional nature of the data precludes the ability to infer causation. The relationship between lifestyle behaviours

and optimal wellbeing is complex and likely to be bidirectional. Intervention and mechanistic studies are required to further progress our understanding of this relationship. The findings from this study provide a starting point for determining the most pertinent lifestyle variables to include in such research.

Conclusion

In this study, two research fields—positive psychology and public health—have been integrated to examine the relationship between lifestyle behaviours and optimal wellbeing. The current study contributes to the limited wellbeing research in New Zealand to show almost a quarter of a large and demographically diverse sample of New Zealanders are meeting the criteria for optimal wellbeing. This study also extends current international knowledge to show sleep, exercise, and sedentary behaviour, and to a lesser degree breakfast consumption, sugary drink intake, BMI, and alcohol consumption are associated with a broader, more complex notion of wellbeing. It is likely this relationship between lifestyle behaviours and optimal wellbeing is bidirectional giving rise to the debate that holistic approaches are needed to promote positive health.

Abbreviations

BDNF: Brain derived neurotrophic factor; BMI: Body mass index; CI: Confidence interval; OR: Odds ratio.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

KP contributed to the design of the manuscript, analysis and interpretation of data, and drafted and revised the manuscript. GS contributed to the design and critical revision of the manuscript. LM critically reviewed the manuscript. All authors read and approved the final manuscript.

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References

- World Health Organization. Constitution of the World Health Organization. In: Basic Documents. Geneva: World Health Organization; 2006.
- Ryff CD, Singer B. The contours of positive human health. *Psychol Ing*. 1998; 9(1):1–28.
- Ryff CD, Singer B, Love GD. Positive health: connecting well-being with biology. *Philos T Roy Soc B*. 2004;359(1383):94.
- Seligman M. Positive health. *Appl Psych Meas*. 2008;57(51):3–18.
- Huppert F, So TC. Flourishing across Europe: application of a new conceptual framework for defining well-being. *Soc Indic Res*. 2013;110(3):837–861.
- Seligman M, Csikszentmihalyi M. Positive psychology: an introduction. *Am Psychol*. 2000;55:5–14.
- Ryff CD, Keyes CLM. The structure of psychological well-being revisited. *J Pers Soc Psychol*. 1995;69:719–27.
- Keyes CLM. The mental health continuum: from languishing to flourishing in life. *J Health Soc Behav*. 2002;43(2):207–222.
- Huppert FA, Marks N, Clark A, Siegrist J, Stutzer A, Vitterso J, et al. Measuring well-being across Europe: description of the ESS well-being module and preliminary findings. *Soc Indic Res*. 2008;91:301–15.
- Diener E, Wirtz D, Tov W, Kim-Prieto C, Choi D-W, Oishi S, et al. New well-being measures: short scales to assess flourishing and positive and negative feelings. *Soc Indic Res*. 2010;97:143–56.
- Seligman M. *Flourish: A visionary new understanding of happiness and well-being*. New York: Free Press; 2012.
- Schotanus-Dijkstra M, Pieterse ME, Drossaert CHC, Westerhof GJ, de Graaf R, ten Have M, et al. What factors are associated with flourishing? Results from a large representative national sample. *J Happiness Stud*. 2015. doi:10.1007/s10902-015-9647-3.
- Grant N, Wardle J, Steptoe A. The relationship between life satisfaction and health behavior: a cross-cultural analysis of young adults. *Int J Behav Med*. 2009;16(3):259–268.
- Piqueras JA, Kuhne W, Vera-Villanova P, Van Straten A, Cuijpers P. Happiness and health behaviours in Chilean college students: a cross-sectional survey. *BMC Public Health*. 2011;11. doi:10.1186/1471-2458-11111-1443.
- Ministry of Health. The health of New Zealand adults 2011/12: key findings of the New Zealand health survey. Wellington: Ministry of Health; 2012.
- Jarden A, Mackay L, White K, Schofield G, Williden M, Hone L, et al. The Sovereign New Zealand Wellbeing Index. *Psychology Aotearoa*. 2013;5(1):22–7.
- van Gelder MM, Breiveld RW, Roelveland N. Web-based questionnaires: the future in epidemiology? *Am J Epidemiol*. 2010;172:1292–8.
- Statistics New Zealand. Household use of information and communication technology: 2012. Wellington: Statistics New Zealand; 2013.
- Census QuickStats about transport and communications. 2013. (<http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-transport-comm.aspx>). Accessed 18 November 2015.
- Ltd SC. ESOMAR. 27 Questions. Auckland: SmileCity Ltd; 2012.
- European Social Survey. ESS Round 6 source questionnaire. London: Centre for Comparative Social Surveys, City University; 2012.
- Ministry of Health. 2006/07 New Zealand health survey: adult questionnaire. Wellington: Ministry of Health; 2006.
- European Social Survey. Round 6 module on personal and social wellbeing: final module in template. London: Centre for Comparative Social Surveys, City University London; 2013.
- Hone L, Jarden A, Schofield G. Measuring flourishing: the impact of operational definitions on the prevalence of high levels of wellbeing. *UNW*. 2014;462–90.
- Statistical standard for ethnicity. (http://www.stats.govt.nz/surveys_and_methods/methods/classifications-and-standards/classification-related-standards/ethnicity.aspx). Accessed 08 December 2012.
- Statistical standard for age. (http://www.stats.govt.nz/surveys_and_methods/methods/classifications-and-standards/classification-related-standards/age.aspx). Accessed 09 December 2013.
- Sullivan C, Calkins J, Young J, Butcher H, Lawson R. Obstacles to action: a study of New Zealanders' physical activity and nutrition. Technical report. AC Nelson: Wellington; 2003.
- Baecke JAH, Burema J, Frijters ER. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr*. 1992;56:936–42.
- European Social Survey. ESS Round 3 source questionnaire. London: Centre for Comparative Social Surveys, City University London; 2006.
- Radloff LS. The CES-D Scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977;1(3):385–401.
- Burgard SA, Allshire JA. Putting work to bed: stressful experiences on the job and sleep quality. *J Health Soc Behav*. 2009;50(4):476–92.
- Kutner NG, Blivise DL, Zhang R. Linking race and well-being within a biopsychosocial framework: variation in subjective sleep quality in two racially diverse older adult samples. *J Health Soc Behav*. 2004;45(1):99–113.
- Body mass index: BMI. (www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi). Accessed 09 December 2015.
- Population estimates. (www.stats.govt.nz/infoshare/SelectVariables.aspx?pxid=598e3be1-1c95-494c-ba1e-af1101e65492). Accessed 09 December 2015.
- Diener E, Diener M. Cross-cultural correlates of life satisfaction and self-esteem. *J Pers Soc Psychol*. 1995;68:653–63.
- Croft AGW, Lawson R. Applying the international wellbeing index to investigate subjective wellbeing of New Zealanders with European and with

- Maori heritage. *Kotuitui: New Zealand Journal of Social Sciences Online*. 2008;3(1):57-72.
37. Sibley C, Harré N, Hoeverd W, Houkamau C. The gap in the subjective wellbeing of Māori and New Zealand Europeans widened between 2005 and 2009. *Soc Indic Res*. 2011;104(1):103-115.
 38. Chant L. Whānau ora: Hauora Māori models for kotahitanga/co-operative co-existence with non-Māori. *AlterNative: An Int J Indigenous Peoples*. 2011; 7(2):111-22.
 39. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. *Sleep*. 2010;33(5):585-92.
 40. Alvarez GG, Ayas NT. The impact of daily sleep duration on health: a review of the literature. *Prog Cardiovasc Nurs*. 2004;19(2):56-9.
 41. Chaput J-P, Tremblay A. Insufficient sleep as a contributor to weight gain: an update. *Current Obesity Reports*. 2012;1(4):245-56.
 42. Salovey P, Detweiler JB, Steward WT, Rothman AJ. Emotional states and physical health. *Am Psychol*. 2000;55(1):110-21.
 43. Gomez-Pinilla F. The influences of diet and exercise on mental health through hormesis. *Ageing Res Rev*. 2008;7:49-62.
 44. Ferris LT, Williams JS, Shen CL. The effect of acute exercise on serum brain-derived neurotrophic factor levels and cognitive function. *Med Sci Sports Exerc*. 2007;39:728-34.
 45. Sharma S, Fulton S. Diet-induced obesity promotes depressive-like behaviour that is associated with neural adaptations in brain reward circuitry. *Int J Obes*. 2013;37:382-9.
 46. Kim JH, Kim SJ, Lee WY, Cheon YH, Lee SS, Ju A, et al. The effects of alcohol abstinence on BDNF, ghrelin, and leptin secretions in alcohol-dependent patients with glucose intolerance. *Alcohol Clin Exp Res*. 2013;37:E52-8.
 47. Sei H, Satoh D, Yamamoto K, Morita K, Morita Y. Differential effect of short-term REM sleep deprivation on NGF and BDNF protein levels in the rat brain. *Brain Res*. 2000;877:387-90.

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Appendix B. The clustering of lifestyle behaviours in New Zealand and their relationship with optimal wellbeing

The final publication is available from link.springer

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The Clustering of Lifestyle Behaviours in New Zealand and their Relationship with Optimal Wellbeing

Kate B. Prendergast¹ · Lisa M. Mackay¹ · Grant M. Schofield¹

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Abstract

Purpose The purpose of this research was to determine (1) associations between multiple lifestyle behaviours and optimal wellbeing and (2) the extent to which five lifestyle behaviours—sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—cluster in a national sample.

Method A national sample of New Zealand adults participated in a web-based wellbeing survey. Five lifestyle behaviours—sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—were dichotomised into healthy (meets recommendations) and unhealthy (does not meet recommendations) categories. Optimal wellbeing was calculated using a multi-dimensional flourishing scale, and binary logistic regression analysis was used to calculate the relationship between multiple healthy behaviours and optimal wellbeing. Clustering was examined by comparing the observed and expected prevalence rates (O/E) of healthy and unhealthy two-, three-, four-, and five-behaviour combinations.

Results Data from 9425 participants show those engaging in four to five healthy behaviours (23 %) were 4.7 (95 % confidence interval (CI) 3.8–5.7) times more likely to achieve optimal wellbeing compared to those engaging in zero to one healthy behaviour (21 %). Clustering was observed for healthy (5 %, O/E 2.0, 95 % CI 1.8–2.2) and unhealthy (5 %, O/E 2.1, 95 % CI 1.9–2.3) five-behaviour combinations

and for four- and three-behaviour combinations. At the two-behaviour level, healthy fruit and vegetable intake clustered with all behaviours, except sleep which did not cluster with any behaviour.

Conclusion Multiple lifestyle behaviours were positively associated with optimal wellbeing. The results show lifestyle behaviours cluster, providing support for multiple behaviour lifestyle-based interventions for optimising wellbeing.

Keywords Lifestyle behaviours · Wellbeing · Positive health · Flourishing

Introduction

Positive health is an emerging paradigm where health is considered beyond the absence of disease [1–3]. Within this paradigm, optimal wellbeing, or flourishing as it is also referred, epitomises positive health. Optimal wellbeing has been operationalised as a multi-dimensional construct incorporating measures of feeling good (e.g. positive emotion, vitality, and resilience) and functioning well (e.g. engagement, competence, and meaning) [4]. Recent epidemiological evidence shows the prevalence of optimal wellbeing in New Zealand is low, with 75 % of the population failing to achieve optimal wellbeing [5]. Similarly, low levels of optimal wellbeing have been reported in many European countries [4]. It is evident from these findings that identifying and promoting behaviours associated with increased wellbeing is warranted.

Walsh [6] argues health professionals have significantly underestimated the importance of lifestyle behaviours for mental health. There is now plausible evidence to indicate individual healthy lifestyle behaviours are associated with optimal wellbeing [5, 7]. Furthermore, findings from a recent study show those who engage in fewer health risk behaviours

✉ Kate B. Prendergast
kate.prendergast@aut.ac.nz

¹ Human Potential Centre, Auckland University of Technology, Private Bag 92006, Auckland 1142, New Zealand

were more likely to be satisfied with their lives [3]. However, it is currently unknown whether a similar positive association occurs between engaging in multiple healthy lifestyle behaviours and optimal wellbeing. As well as understanding the relationship between multiple behaviours and optimal wellbeing, examining the distribution of these behaviours within the population would be useful for intervention planning [8]. If lifestyle behaviours cluster, interventions targeting multiple lifestyle behaviours may be more efficient and cost-effective than promoting lifestyle behaviours in isolation [9].

Clustering can be used to examine whether lifestyle behaviours co-occur or occur independently in a population [10]. In previous studies, between three and five lifestyle behaviours have been dichotomised into healthy (e.g. meets physical activity recommendations) and unhealthy (e.g. does not meet physical activity recommendations) behaviours and the clustering of healthy and unhealthy behaviour combinations have been explored [10–13]. Whilst there is now increasing international research in this area, evidence on the clustering of lifestyle behaviours in New Zealand is limited and the findings mixed [12, 13]. Tobias et al. [12], for example, examined the clustering of four lifestyle behaviours—physical activity, fruit and vegetable intake, alcohol, and smoking—in a sample of 10,241 New Zealand adults with no history of cardiovascular disease or cancer. The authors found unhealthy lifestyle behaviours clustered together; however, healthy lifestyle behaviours clustered to a lesser degree. In a more recent study, Williden et al. [13] examined the clustering of body mass index and two lifestyle behaviours—physical activity and fruit and vegetable consumption—in a sample of 1296 white-collared employees. In contrast to the results of Tobias et al. [12], no evidence was found to support the clustering of healthy or unhealthy lifestyle behaviours [13]. These contrasting findings indicate further research is needed to develop a more comprehensive understanding of the distribution of lifestyle behaviours in New Zealand.

The selection of lifestyle behaviours has varied in both the international [8, 14–17] and national [12, 13] clustering literature. Nonetheless, most of the lifestyle behaviours investigated in these studies were chosen due to their explicit associations with chronic disease (e.g. lack of physical activity, inadequate fruit and vegetable intake, alcohol consumption, and smoking) [8, 12–17]. Few studies have, however, explored the clustering of other lifestyle behaviours—including sedentary behaviour, sleep, or sugar consumption—which are associated not only with health [18–20] but also with wellbeing [5, 21]. There is now evidence to show sedentary behaviour, for example, is adversely associated with health [18] and wellbeing [5, 21], independently of physical activity. Similarly, inverse associations between sugar consumption and health [20] and wellbeing [5] have

been documented in the literature. Understanding how lifestyle behaviours, associated with health and wellbeing, are dispersed across the population would be useful for informing positive health interventions. The aims of this study are twofold: (1) to advance the literature by determining the association between multiple lifestyle behaviours and optimal wellbeing and (2) to extend beyond conventional behaviours to determine the extent to which behaviours—including sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—cluster in a national sample of New Zealand adults.

Methods

Study Design

Data were drawn from the Sovereign Wellbeing Index (Round 1), a cross-sectional study of wellbeing in New Zealand which has been described in detail elsewhere [5, 22]. Ethical approval to conduct the study was granted by the Auckland University of Technology Ethics Committee (AUTC 12/201).

Participants

Participants were recruited from the largest commercial database in New Zealand. A total of 38,439 New Zealand adults (aged over 18 years) were invited via email to participate in a web-based wellbeing survey. The web-based survey utilised a point-and-click interface and included 134 questions on wellbeing, health and lifestyle, and socio-demographics. Data were collected between September 2012 and October 2012. All participants provided informed consent prior to entering the survey.

Measures

Measures specific to the current study only are described in detail below.

Lifestyle Behaviours

Five lifestyle behaviours were selected for inclusion in this study: sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake. Each lifestyle behaviour was dichotomised into healthy and unhealthy categories.

Sleep was measured using a single item (*How much of the time during the past week did you experience restless sleep?*) drawn from the European Social Survey (Round 6) [23]. Similar to previous research, responses were dichotomised into healthy (experiencing restless sleep none/almost none of the

time or some of the time) and unhealthy (experiencing restless sleep most or all/almost all of the time) categories [24, 25].

Physical activity and sedentary behaviour were measured using the Lifestyle Physical Activity and Sedentary Scale, an original scale developed for the Sovereign Wellbeing Index [26]. Physical activity was assessed using six items which took into account lifestyle physical activity, active transport, and purposeful exercise. Responses were used to profile individuals' physical activity as very low, low, moderate, or high. Very low and low physical activity profiles were classified as unhealthy (i.e. falling substantially below or doing some activity but unlikely to be meeting the Ministry of Health's guidelines for physical activity), whilst moderate and high physical activity profiles were classified as healthy (i.e. meeting or exceeding the Ministry of Health's guidelines for physical activity) [27].

Sedentary scores were calculated using a single-item sitting question (*How much of the time during the past week did you spend sitting?*) from the Lifestyle Physical Activity and Sedentary Scale [5, 26]. Based on their responses, the participants were classified as having very low (none/almost none of the time), low (a little of the time), moderate (some of the time), or high (most or all/almost all of the time) sedentary levels. There are currently no standardised thresholds for classifying unhealthy and healthy levels of sedentary behaviour. The following dichotomies were, therefore, utilised for this study: low and very low sedentary levels were classified as healthy; moderate and high sedentary levels were classified as unhealthy.

Sugary drink consumption was used as a proxy for sugar intake and was assessed using a single-item question (*How often during the past week did you drink sugary beverages?*) [28]. Respondents were instructed to include all energy drinks, carbonated drinks (i.e. fizzy drinks), fruit juice, and cordial (diet drinks were excluded). Current Ministry of Health guidelines were used to classify sugary drink consumption as healthy (<1 time/week) and unhealthy (≥ 1 time/week) [27].

Fruit and vegetable intake were measured using two questions drawn from the New Zealand Health Survey [28]. The questions asked participants to report on average how many servings of fruit and vegetables they had each day over the past week. Current Ministry of Health guidelines were used to classify fruit and vegetable intake as healthy (≥ 2 servings of fruit and ≥ 3 servings of vegetables) or unhealthy (<2 servings of fruit or <3 servings of vegetables) [29].

Optimal Wellbeing

Optimal wellbeing was treated as a binary variable and was calculated using a modified version of Huppert and So's flourishing scale [4, 30]. Ten items, originally drawn from the European Social Survey (Round 6) [31], were used to calculate optimal wellbeing. The ten items included measures of happiness, vitality, optimism, resilience, self-esteem,

emotional stability engagement, meaning, optimism, and positive relationships [4]. These items combine both hedonic (feelings) and eudaimonic (functioning) aspects of wellbeing and were designed to mirror the internationally agreed criteria for depression and anxiety [4]. Items were rated on 4-point to 11-point Likert scales [30]. All items were phrased in a positive direction except for the item measuring resilience, which was reverse coded. The thresholds of Hone et al. [30] were used to calculate whether participants met the criteria for each item. Optimal wellbeing was determined as meeting the thresholds for positive emotion (happiness), four out of five features of positive characteristics (vitality, optimism, resilience, self-esteem, emotional stability), and three out of four features of positive functioning (engagement, meaning, optimism, positive relationships) [30].

Data Analysis

Multiple Lifestyle Behaviours and Optimal Wellbeing

Firstly, the prevalence of healthy and unhealthy dichotomies was calculated for each lifestyle behaviour. To determine whether engaging in multiple healthy lifestyle behaviours was associated with optimal wellbeing, the prevalence rates of the sample engaging in zero to five healthy lifestyle behaviours were calculated. Binary logistic regression analyses (IBM SPSS Statistics version 19 for Windows) were used to calculate crude and adjusted (age, gender, ethnicity, and household income) odds ratios and 95 % confidence intervals (CI) for being in the optimal wellbeing group. The alpha was set at $p < 0.05$ to determine statistical significance.

Clustering Clustering ratios (observed prevalence/expected prevalence), 95 % CIs, and the prevalence of optimal wellbeing were calculated for all possible healthy and unhealthy two-, three-, four-, and five-behaviour combinations. The observed prevalence was calculated as the proportion of the sample in each behaviour combination examined in this study. The expected prevalence was calculated by multiplying the observed prevalence of the individual behaviours together (e.g. healthy sleep*healthy physical activity) [13]. These clustering ratios were used to determine whether lifestyle behaviours clustered or occurred independently in the sample. Ratios >1 indicated clustering (i.e. the observed prevalence is higher than the expected prevalence); ratios <1 indicated that the behaviours occurred independently [12, 32].

Results

Participant Characteristics

In total, 9962 New Zealand adults completed the survey. Participants were excluded from analysis if they were missing

data from any of the five lifestyle behaviours (5 %; $n=537$). Thus, valid data were available from 9425 (47 % male) participants. Table 1 provides a summary of the participant characteristics.

Prevalence of Individual Behaviours

Of the total sample, 69 % experienced healthy sleep, 58 % had healthy levels of physical activity, 60 % had healthy sedentary levels, 43 % had a healthy consumption of sugary drinks, and 25 % had a healthy fruit and vegetable intake.

Multiple Lifestyle Behaviours and Optimal Wellbeing

Overall, 5 % of the sample reported not engaging in any healthy lifestyle behaviours and 5 % reported engaging in all five healthy lifestyle behaviours over the past week (Fig. 1).

Optimal wellbeing data were available for 9235 participants. In total, 24 % of the sample met the criteria for optimal wellbeing. Table 2 shows the prevalence of optimal wellbeing and the likelihood of being in the optimal wellbeing group based on the number of healthy lifestyle behaviours endorsed. The adjusted odds ratios show that those engaging in four or five healthy lifestyle behaviours were 4.7 (95 % CI 3.8–5.7) times more likely to fall into the optimal wellbeing group compared to those engaging in zero to one healthy lifestyle behaviour.

Table 1 Participant characteristics ($n=9425$)

	Number (n)	Percent (%)
Gender		
Male	4415	47
Female	4993	53
Missing	17	0.2
Age		
<40 years	3513	37
40–59 years	2740	29
≥60 years	1895	20
Missing	1277	14
Household income tertile		
≤\$40,000	2351	25
\$40,001–\$90,000	2523	27
≥\$90,001	2204	23
Missing	2347	25
Ethnicity		
European/other	7045	75
Asian	987	11
Maori/Pacific	1222	13
Missing	171	2

Clustering

Tables 3 and 4 show the clustering ratios, 95 % CIs, and the prevalence of optimal wellbeing for two-, three-, four-, and five-lifestyle behaviour combination patterns.

Five-Behaviour Combinations Clustering—indicated by a ratio >1.0—was observed for both the healthy and unhealthy five-behaviour combinations. The observed prevalence of having all five healthy (cluster ratio 2.0, 95 % CI 1.8–2.2) or unhealthy (cluster ratio 2.1, 95 % CI 1.9–2.3) behaviours was higher than could have been expected on the basis of the individual probabilities of the five behaviours alone. In total, 47 % (95 % CI 43–51) of people who met the guidelines for all five healthy behaviours were classified as having optimal levels of wellbeing. Conversely, 6 % (95 % CI 4–8) of the unhealthy group were classified as having optimal levels of wellbeing.

Four-Behaviour Combinations Clustering was observed in all four-behaviour combinations. The greatest degree of clustering was observed between the healthy combination of sleep, physical activity, sedentary behaviour, and fruit and vegetable intake (2.1, 95 % CI 2.0–2.3). In total, 10 % of the sample met these four healthy behaviours and the prevalence of optimal wellbeing within this group was 44 % (95 % CI 40–47). Of the unhealthy behaviour combinations, the greatest degree of clustering was observed between sleep, physical activity, sedentary behaviour, and sugary drinks (1.8, 95 % CI 1.6–1.9). For this group, the prevalence of optimal wellbeing was 6 % (95 % CI 4–8 %).

Three-Behaviour Combinations A degree of clustering was observed between all three-behaviour combinations, except the healthy combination of sleep, physical activity, and sugary drinks (1.1, 95 % CI 1.0–1.1). Of the healthy behaviour combinations, the greatest degree of clustering was observed between physical activity, sedentary behaviour, and fruit and vegetable intake (1.4, 95 % CI 1.3–1.5) and between physical activity, sugary drinks, and fruit and vegetable intake (1.4, 95 % CI 1.3–1.4). For the unhealthy behaviours, physical activity, sedentary behaviour, and sugary drink consumption (1.5, 95 % CI 1.4–1.6) and physical activity, sedentary behaviour, and fruit and vegetable intake (1.5, 95 % CI 1.4–1.6) showed the greatest degree of clustering.

Two-Behaviour Combinations Most of the healthy and unhealthy two-behaviour patterns showed a degree of clustering. For the healthy lifestyle behaviours, the greatest degree of clustering was observed between physical activity and sedentary behaviour (1.2, 95 % CI 1.1–1.2) and between sugary drink consumption and fruit and vegetable intake (1.2, 95 % CI 1.1–1.2). A healthy fruit and vegetable consumption clustered with

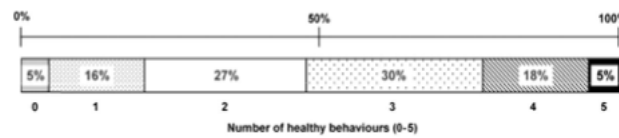


Fig. 1 The proportion of the sample engaging in nil to five healthy lifestyle behaviours. The participants were asked to report on their engagement in five lifestyle behaviours (sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake) over the past week

all behaviours (physical activity, sedentary behaviour, and sugary drinks), except sleep. For the unhealthy lifestyle behaviours, only physical activity and sedentary behaviour clustered (1.4, 95 % CI 1.3–1.4). At the two-behaviour level, sleep did not cluster with any other behaviour.

In summary, the greatest degree of clustering was observed between the healthy combination of sleep, physical activity, sedentary behaviour, and fruit and vegetable intake and the unhealthy combination of sleep, physical activity, sedentary behaviour, sugar drinks, and fruit and vegetable intake. The prevalence of optimal wellbeing was higher in the healthy behaviour combinations compared to the unhealthy behaviour combinations.

Discussion

The first aim of this study was to determine the association between multiple lifestyle behaviours and optimal wellbeing in a national sample of New Zealand adults. The results showed a positive association between the number of healthy lifestyle behaviours endorsed and the likelihood of achieving the criteria for optimal wellbeing. Those engaging in four or five healthy lifestyle behaviours were 4.7 (95 % CI 3.8–5.7) times more likely to achieve the criteria for optimal wellbeing compared to those engaging in none or one healthy lifestyle behaviour. The second aim of this study was to investigate the extent to which five lifestyle behaviours—sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake—clustered. In this study, clustering was observed for healthy and unhealthy five-, four- and three-behaviour combinations, though the extent to which the

behaviours clustered varied. Evidence of clustering was less consistent for the two-behaviour combinations.

The findings from this study indicate engaging in multiple lifestyle behaviours may have a synergistic effect on optimal wellbeing. We show the likelihood of achieving optimal wellbeing increases with the number of healthy lifestyle behaviours endorsed. Nearly 50 % of the group engaging in all five healthy behaviours met the criteria for optimal wellbeing, compared to just 6 % of those engaging in no healthy lifestyle behaviours. Our results are consistent with previous research which has shown that engaging in fewer health risk behaviours is associated with increased satisfaction with life [3]. It was, therefore, concerning to find only 5 % of the sample engaged in all five healthy lifestyle behaviours. Similar low prevalence rates (3–8 %) for meeting multiple healthy lifestyle behaviours have been reported elsewhere [13, 14, 17].

Although causation cannot be inferred from our data, findings from intervention studies provide evidence to suggest improvements in isolated behaviours result in improved wellbeing outcomes [33]. Findings from a recent study, for example, show participation in a 4-week fitness programme had a significant and positive effect on satisfaction with life [33]. There is also emerging research to suggest the influence of multiple healthy lifestyle behaviours on optimal wellbeing is biologically plausible [34]. Engaging in healthy lifestyle behaviours enhances neuroplasticity by reducing inflammation and increasing the expression of brain-derived neurotrophic growth factor [35, 36]. Research shows neuroplasticity is essential for many of the dimensions underpinning optimal wellbeing such as creativity, exploration, and curiosity [7, 34]. Engaging in a combination of healthy behaviours which cause an overall reduction in inflammation and enhancement in

Table 2 Prevalence and likelihood of being in the optimal wellbeing group based on the number of healthy lifestyle behaviours endorsed ($n = 9235$)

	Non-optimal wellbeing, n (%)	Optimal wellbeing, n (%)	Crude odds ratio (95 % CI)	Adjusted ^a odds ratio (95 % CI)
Total	6979 (76)	2256 (24)		
0–1 healthy behaviour(s)	1697 (89)	213 (11)	Reference	Reference
2–3 healthy behaviours	4024 (77)	1177 (23)	2.3 (2.0–2.7)	2.2 (1.8–2.7)
4–5 healthy behaviours	1258 (59)	866 (41)	5.5 (4.6–6.5)	4.7 (3.8–5.7)

CI confidence interval

^a Adjusted for age, gender, ethnicity, and household income

Table 3 Prevalence of combinations of healthy lifestyle behaviours

	Observed		Expected	Cluster ratio	Optimal wellbeing
	<i>n</i>	%	%	O/E (95 % CI)	% (95 % CI)
Individual behaviours					
Sleep	6526	69			31 (29–32)
Physical activity (PA)	5436	58			29 (27–30)
Sedentary behaviour (SB)	5635	60			29 (27–30)
Sugary drinks	4080	43			29 (28–30)
Fruit and vegetables (FV)	2389	25			33 (31–35)
Two-behaviour combinations					
Sleep*PA	3868	41	40	1.0 (1.0–1.1)	35 (34–37)
Sleep*SB	4026	43	41	1.0 (1.0–1.1)	35 (34–37)
Sleep*sugary drinks	2923	31	30	1.0 (1.0–1.1)	36 (34–37)
Sleep*FV	1791	19	18	1.1 (1.0–1.1)	39 (37–41)
PA*SB	3849	41	34	1.2 (1.1–1.2)	31 (30–33)
PA*sugary drinks	2390	25	25	1.0 (1.0–1.1)	33 (32–35)
PA*FV	1572	17	15	1.1 (1.1–1.2)	36 (34–39)
SB*sugary drinks	2578	27	26	1.1 (1.0–1.1)	33 (31–35)
SB*FV	1602	17	15	1.1 (1.1–1.2)	37 (34–39)
Sugary drinks*FV	1220	13	11	1.2 (1.1–1.2)	37 (34–40)
Three-behaviour combinations					
Sleep*PA*SB	2761	29	24	1.2 (1.2–1.3)	38 (36–40)
Sleep*PA*sugary drinks	1775	19	17	1.1 (1.0–1.1)	40 (38–42)
Sleep*PA*FV	1201	13	10	1.3 (1.2–1.3)	41 (39–44)
Sleep*SB*sugary drinks	1916	20	18	1.1 (1.1–1.2)	40 (38–42)
Sleep*SB*FV	1245	13	10	1.3 (1.2–1.3)	42 (39–45)
Sleep*sugary drinks*FV	945	10	8	1.3 (1.2–1.4)	43 (40–46)
PA*SB*sugary drinks	1738	18	15	1.2 (1.2–1.3)	36 (34–38)
PA*SB*FV	1169	12	9	1.4 (1.3–1.5)	39 (36–41)
PA*sugary drinks*FV	806	9	6	1.4 (1.3–1.4)	40 (37–44)
SB*sugary drinks*FV	830	9	7	1.3 (1.3–1.4)	41 (38–45)
Four-behaviour combinations					
Sleep*PA*SB*sugary drinks	1308	14	10	1.3 (1.3–1.4)	42 (40–45)
Sleep*PA*SB*FV	911	10	5	2.1 (2.0–2.3)	44 (40–47)
Sleep*PA*sugary drinks*FV	643	7	4	1.6 (1.4–1.7)	45 (41–49)
Sleep*SB*sugary drinks*FV	669	7	5	1.6 (1.4–1.7)	46 (42–50)
PA*SB*sugary drinks*FV	608	6	4	1.7 (1.6–1.8)	43 (39–47)
Five-behaviour combination					
Sleep*PA*SB*sugary drinks*FV	495	5	3	2.0 (1.8–2.2)	47 (43–51)

O/E observed prevalence/expected prevalence

brain-derived neurotrophic growth factor is, therefore, likely to have positive implications for wellbeing.

International research provides compelling evidence to support the clustering of lifestyle behaviours [16]. Previous studies show lifestyle behaviours cluster at both ends of the unhealthy–healthy spectrum, with more people than expected engaging in all unhealthy behaviours or all healthy behaviours [14, 16, 37]. Despite the inclusion of different lifestyle behaviours—including sugary drink consumption, sedentary behaviour, and

sleep—the results of the current study are consistent with this international research showing clustering at both ends of the spectrum. Nonetheless, the results from the current study contrast with those of previous national research which has provided little evidence to support the clustering of lifestyle behaviours in New Zealand [12, 13]. These differences may be attributed to the number and type of lifestyle behaviours included, the use of a homogenous sample [13], or the exclusion of people diagnosed with cardiovascular disease or cancer [12].

Table 4 Prevalence of combinations of unhealthy lifestyle behaviours

	Observed		Expected	Cluster ratio	Optimal wellbeing
	<i>n</i>	%	%	O/E (95 % CI)	% (95 % CI)
Individual behaviours					
Sleep	2899	31			11 (9–12)
Physical activity (PA)	3989	42			19 (17–20)
Sedentary behaviour (SB)	3790	40			18 (17–20)
Sugary drinks	5345	57			21 (20–22)
Fruit and vegetables (FV)	7036	75			21 (21–22)
Two-behaviour combinations					
Sleep*PA	1331	14	13	1.1 (1.0–1.1)	8 (6–9)
Sleep*SB	1290	14	12	1.1 (1.0–1.2)	9 (7–10)
Sleep*sugary drinks	1742	18	17	1.1 (1.0–1.1)	10 (8–11)
Sleep*FV	2301	24	23	1.1 (1.0–1.1)	9 (8–10)
PA*SB	2203	23	17	1.4 (1.3–1.4)	15 (14–17)
PA*sugary drinks	2299	24	24	1.0 (1.0–1.1)	16 (14–17)
PA*FV	3172	34	32	1.1 (1.0–1.1)	16 (15–18)
SB*sugary drinks	2288	24	23	1.1 (1.0–1.1)	16 (15–18)
SB*FV	3003	32	30	1.1 (1.0–1.1)	16 (15–18)
Sugary drinks*FV	4176	44	42	1.0 (1.0–1.1)	19 (18–20)
Three-behaviour combinations					
Sleep*PA*SB	810	9	5	1.6 (1.5–1.8)	7 (5–9)
Sleep*PA*sugary drinks	789	8	7	1.1 (1.1–1.2)	7 (5–9)
Sleep*PA*FV	1104	12	10	1.2 (1.1–1.3)	7 (6–9)
Sleep*SB*sugary drinks	795	8	7	1.2 (1.1–1.3)	8 (6–10)
Sleep*SB*FV	1049	11	9	1.2 (1.1–1.3)	8 (6–10)
Sleep*sugary drinks*FV	1419	15	13	1.2 (1.1–1.2)	8 (7–10)
PA*SB*sugary drinks	1353	14	10	1.5 (1.4–1.6)	13 (12–15)
PA*SB*FV	1819	19	13	1.5 (1.4–1.6)	14 (12–15)
PA*sugary drinks*FV	1896	20	18	1.1 (1.1–1.2)	14 (13–16)
SB*sugary drinks*FV	1891	20	17	1.2 (1.1–1.2)	15 (13–16)
Four-behaviour combinations					
Sleep*PA*SB*sugary drinks	500	5	3	1.8 (1.6–1.9)	6 (4–8)
Sleep*PA*SB*FV	682	7	5	1.4 (1.3–1.5)	7 (5–9)
Sleep*PA*sugary drinks*FV	674	7	6	1.3 (1.2–1.4)	7 (5–9)
Sleep*SB*sugary drinks*FV	668	7	5	1.4 (1.3–1.5)	7 (5–9)
PA*SB*sugary drinks*FV	1161	12	7	1.7 (1.6–1.8)	13 (11–15)
Five-behaviour combination					
Sleep*PA*SB*sugary drinks*FV	436	5	2	2.1 (1.9–2.3)	6 (4–8)

O/E observed prevalence/expected prevalence

To our knowledge, the current study is the first to examine the extent to which sleep, physical activity, sedentary behaviour, sugary drink consumption, and fruit and vegetable intake cluster. It was interesting to note that the healthy combination of sleep, physical activity, and sugary drink consumption was the only three-behaviour combination which did not cluster (1.1, 95 % CI 1.0–1.1). Furthermore, at the two-behaviour level, sleep did not cluster with any other behaviour, though it clustered at the three-, four- and

five-behaviour level. In contrast, physical activity and sedentary behaviour clustered to the greatest degree, particularly for the unhealthy combination (1.4, 95 % CI 1.3–1.4). Although these two behaviours are each independently associated with health [18] and wellbeing [5, 21], the current study indicates they occur among the same people in the population suggesting both behaviours should be targeted in interventions. It was also interesting to find that, for healthy behaviours, the greatest degree of clustering was

not observed between all five behaviours. Rather, the four-behaviour combination of sleep, physical activity, sedentary behaviour, and fruit and vegetable intake showed a greater degree of clustering. Based on these results, lifestyle interventions should target multiple behaviours, though increased emphasis should be placed on increasing physical activity, minimising sedentary behaviour, improving sleep, and consuming fruit and vegetables.

Due to the cross-sectional design of clustering studies, it is difficult to determine why lifestyle behaviours cluster together, especially at the unhealthy and healthy ends of the spectrum. Clustering may partly be explained by social and environmental factors [38]. There is, however, some evidence to suggest the clustering of lifestyle behaviours may be influenced by a behaviour-biochemistry feedback loop [39]. For example, several researchers have demonstrated a negative behaviour-biochemistry feedback loop in their research [39–42]. They show chronically raised insulin resulting from poor lifestyle choices—such as a poor-quality diet, sedentary behaviour, and poor sleep—blocks leptin signalling to the hypothalamus. As leptin is an energy-regulating hormone, the body's ability to regulate energy is impaired. This results in the body initiating an adaptive response to "starvation"; individuals will feel like eating more and moving less, despite having consumed calories in excess [41]. It is plausible a similar positive feedback loop may exist.

The evidence to support clustering in the present study raises the possibility of employing multiple behaviour change interventions to enhance wellbeing. There is currently a small, but growing, body of work in which the utility of multiple behaviour change interventions has been explored [43]. Several benefits of multiple behaviour change interventions have been identified at both the individual and population levels [9]. For individuals, successfully improving one or more lifestyle behaviours may lead to the confidence and self-efficacy to improve others [9]. At the population level, there is evidence to suggest that targeting multiple behaviours concurrently is likely to be both efficient and cost-effective [9]. An intervention targeting the five behaviours we examined, for instance, would have relevance to 95 % of our sample as only 5 % of our sample engaged in all five healthy lifestyle behaviours. Conversely, an intervention focusing on just physical activity would only have relevance to the 48 % of the sample not engaging in the behaviour. Given the potential benefits, further research investigating the use of multiple behaviour change interventions for improving wellbeing outcomes is warranted.

Strengths of this study include the use of a large heterogeneous sample which represents New Zealand adults across a range of age, income, and ethnic demographics. Limitations of the study include the cross-sectional design, which precludes the ability to infer causation. Further, the web-based recruitment strategy may also be considered a source of bias.

However, findings from a review paper show the age, gender, income, education, and health status of subjects responding to a web-based survey are comparable to those responding to traditional modes of data collection [44]. Notwithstanding the study's limitations, this research shows diverse behaviours including sleep, sedentary behaviour, and to a lesser degree sugary drink consumption cluster with physical activity and fruit and vegetable intake. Furthermore, this research advances both the public health and positive psychology literature to show, for the first time, that lifestyle behaviours associated with the optimal wellbeing cluster.

Conclusion

This research has shown there is a positive association between the number of healthy lifestyle behaviours endorsed and optimal wellbeing. Furthermore, the findings support the notion that lifestyle behaviours cluster at both ends of the healthy and unhealthy spectrum. These results suggest further research investigating the use of multiple behaviour change interventions for improving optimal wellbeing is warranted.

Acknowledgments The authors would like to acknowledge Sovereign's ongoing support as the funder of this research. KP was supported by a Sovereign Wellbeing Index Doctoral Scholarship.

Compliance with Ethical Standards All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval to conduct the study was granted by the Auckland University of Technology Ethics Committee (AUTECH 12/201).

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Conflict of Interest The authors declare that they have no conflict of interest.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. Seligman M. Positive health. *Appl Psychol Meas.* 2008;57(S1):3–18. doi:10.1111/j.1464-0597.2008.00351.x.
2. Vazquez C, Hervas G, Rahona J, Gomez D. Psychological wellbeing and health: contributions of positive psychology. *Annuary Clin Health Psychol.* 2009;5:15–27.
3. Evers KE, Castle PH, Prochaska JO, Prochaska JM. Examining relationships between multiple health risk behaviors, well-being, and productivity. *Psychol Rep.* 2014;114(3):843–53. doi:10.2466/13.01.PR0.114k25w4.

4. Huppert F, So TC. Flourishing across Europe: application of a new conceptual framework for defining well-being. *Soc Indic Res*. 2013;110(3):837–61. doi:10.1007/s11205-011-9966-7.
5. Prendergast KB, Schofield GM, Mackay LM. Associations between lifestyle behaviours and optimal wellbeing in a diverse sample of New Zealand adults. *BMC Public Health*. 2016;16(62). doi:10.1186/s12889-016-2755-0.
6. Walsh R. Lifestyle and mental health. *Am Psychol*. 2011;66(7):579–92.
7. Conner TS, Brookie KL, Richardson AC, Polak MA. On carrots and curiosity: eating fruit and vegetables is associated with greater flourishing in daily life. *Br J Health Psychol*. 2015. doi:10.1111/bjhp.12113.
8. Conry MC, Morgan K, Curry P, et al. The clustering of health behaviours in Ireland and their relationship with mental health, self-rated health and quality of life. *BMC Public Health*. 2011. doi:10.1186/1471-2458-11-692.
9. Prochaska JJ, Spring B, Nigg CR. Multiple health behavior change research: an introduction and overview. *Prev Med*. 2008;46(3):181–8. doi:10.1016/j.ypmed.2008.02.001.
10. McAloney K, Graham H, Law C, Platt L. A scoping review of statistical approaches to the analysis of multiple health-related behaviours. *Prev Med*. 2013;56(6):365–71. doi:10.1016/j.ypmed.2013.03.002.
11. Pronk NP, Anderson LH, Crain AL, et al. Meeting recommendations for multiple healthy lifestyle factors: prevalence, clustering, and predictors among adolescent, adult, and senior health plan members. *Am J Prev Med*. 2004;27(2 Suppl):25–33. doi:10.1016/j.amepre.2004.04.022.
12. Tobias M, Jackson G, Yeh L-C, Huang K. Do healthy and unhealthy behaviours cluster in New Zealand? *Aust N Z J Public Health*. 2007;31(2):155–63. doi:10.1111/j.1753-6405.2007.00034.x.
13. Williden M, Duncan S, Schofield G. Do health behaviours cluster in a working population in New Zealand? *Health Promot J Aust*. 2012;23(3):234–6.
14. Poortinga W. The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Prev Med*. 2007;44(2):124–8. doi:10.1016/j.ypmed.2006.10.006.
15. Baruth M, Addy C, Wilcox S, Dowda M. Clustering of risk behaviours among African American adults. *Health Educ J*. 2011;71(5):565–75. doi:10.1177/0017896911411761.
16. Berrigan D, Dodd K, Troiano RP, Krebs-Smith SM, Barbash RB. Patterns of health behavior in U.S. adults. *Prev Med*. 2003;36(5):615–23. doi:10.1016/s0091-7435(02)00067-1.
17. French S, Rosenberg M, Knuiiman M. The clustering of health behaviours in a Western Australian adult population. *Health Promot J Aust*. 2008;19(3):203–9.
18. Helmerhorst HJF, Wijndaele K, Brage S, Wareham NJ, Ekelund U. Objectively measured sedentary time may predict insulin resistance independent of moderate- and vigorous-intensity physical activity. *Diabetes*. 2009;58(8):1776–9.
19. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. *Sleep*. 2010;33(5):585–92.
20. Brown CM, Dulloo AG, Montani JP. Sugary drinks in the pathogenesis of obesity and cardiovascular diseases. *Int J Obes*. 2008;32(S6):S28–34. doi:10.1038/sj.ijo.2008.204.
21. Atkin A, Adams E, Bull F, Biddle S. Non-occupational sitting and mental well-being in employed adults. *Ann Behav Med*. 2012;43(2):181–8. doi:10.1007/s12160-011-9320-y.
22. Jarden A, Mackay L, White K, et al. The sovereign New Zealand wellbeing index. *Psychol Aotearoa*. 2013;5(1):22–7.
23. European Social Survey. ESS Round 3 source questionnaire. London: Centre for Comparative Social Surveys, City University London; 2006.
24. Kutner NG, Bliwise DL, Zhang R. Linking race and well-being within a biopsychosocial framework: variation in subjective sleep quality in two racially diverse older adult samples. *J Health Soc Behav*. 2004;45(1):99–113.
25. Burgard SA, Ailshire JA. Putting work to bed: stressful experiences on the job and sleep quality. *J Health Soc Behav*. 2009;50(4):476–92.
26. Hone LC, Jarden A, Duncan S, Schofield GM. Flourishing in New Zealand workers: associations with lifestyle behaviors, physical health, psychosocial, and work-related indicators. *J Occup Environ Med*. 2015;57(9):973–83. doi:10.1097/JOM.0000000000000508.
27. Ministry of Health. Eating and activity guidelines for New Zealand adults. Wellington: Ministry of Health; 2015.
28. Ministry of Health. 2006/07 New Zealand health survey: adult questionnaire. Wellington: Ministry of Health; 2006.
29. Ministry of Health. New Zealand health strategy. Wellington: Ministry of Health; 2000.
30. Hone L, Jarden A, Schofield G. Measuring flourishing: the impact of operational definitions on the prevalence of high levels of wellbeing. *Int J Wellbeing*. 2014;4(1):62–90. doi:10.5502/ijw.v4i1.4.
31. European Social Survey. ESS Round 6 source questionnaire. London: Centre for Comparative Social Surveys, City University; 2012.
32. Ebrahim S, Montaner D, Lawlor DA. Clustering of risk factors and social class in childhood and adulthood in British women's heart and health study: cross sectional analysis. *Br Med J*. 2004. doi:10.1136/bmj.38034.702836.55.
33. Wicker P, Coates D, Breuer C. The effect of a four-week fitness program on satisfaction with health and life. *Int J Public Health*. 2015;60(1):41–7. doi:10.1007/s00038-014-0601-7.
34. Gomez-Pinilla F. The influences of diet and exercise on mental health through hormones. *Ageing Res Rev*. 2008;7(1):49–62. doi:10.1016/j.arr.2007.04.003.
35. Rothman SM, Mattson MP. Activity-dependent, stress-responsive BDNF signaling and the quest for optimal brain health and resilience throughout the lifespan. *Neuroscience*. 2013;239:228–40. doi:10.1016/j.neuroscience.2012.10.014.
36. Mattson MP. Dietary factors, hormones and health. *Ageing Res Rev*. 2008;7(1):43–8. doi:10.1016/j.arr.2007.08.004.
37. Laaksonen M, Prattala R, Karisto A. Patterns of unhealthy behaviour in Finland. *Eur J Public Health*. 2001;11(3):294–300.
38. Spring B, Moller AC, Coons MJ. Multiple health behaviours: overview and implications. *J Public Health*. 2012;34(S1):S3–10. doi:10.1093/pubmed/fdr111.
39. Lustig RH. Which comes first? The obesity or the insulin? The behavior or the biochemistry? *J Pediatr*. 2008;152(5):601–2. doi:10.1016/j.jpeds.2008.01.021.
40. Mark AL, Rahmouni K, Correia M, Haynes WG. A leptin-sympathetic-leptin feedback loop: potential implications for regulation of arterial pressure and body fat. *Acta Physiol Scand*. 2003;177(3):345–9. doi:10.1046/j.1365-201X.2003.01085.x.
41. Isganaitis E, Lustig RH. Fast food, central nervous system insulin resistance, and obesity. *Arterioscler Thromb Vasc Biol*. 2005;25(12):2451–62. doi:10.1161/01.ATV.0000186208.06964.91.
42. Lustig RH, Sen S, Soberman JE, Velasquez-Miery PA. Obesity, leptin resistance, and the effects of insulin reduction. *Int J Obes Relat Metab Disord*. 2004;28(10):1344–8. doi:10.1038/sj.ijo.0802753.
43. Prochaska JJ, Prochaska JO. A review of multiple health behavior change interventions for primary prevention. *Am J Lifestyle Med*. 2011;5(3):208–21. doi:10.1177/1559827610391883.
44. van Gelder MM, Bretveld RW, Roelleveld N. Web-based questionnaires: the future in epidemiology? *Am J Epidemiol*. 2010. doi:10.1093/aje/kwq291.

Appendix C. Ethics approval: Chapters 3 and 4



MEMORANDUM

Auckland University of Technology Ethics Committee (AUTC)

To: Grant Schofield
From: Rosemary Godbold, Executive Secretary, AUTC
Date: 23 August 2012
Subject: Ethics Application Number 12/201 Sovereign Wellbeing Index

Dear Grant

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 (AUTC) at their meeting on 13 August 2012 and I have approved your ethics application. This delegated approval is made in accordance with section 5.3.2.3 of AUTC's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement by AUTC at its meeting on 10 September 2012.

Your ethics application is approved for a period of three years until 23 August 2015.

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

- 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 23 August 2015;
- 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 23 August 2015 or on completion of the project, whichever comes sooner;

It is a condition of approval that AUTC is notified of any adverse events or if the research does not commence. AUTC 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 AUTC 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.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all written and verbal correspondence with us. Should you have any further enquiries regarding this matter, you are welcome to contact me by email at ethics@aut.ac.nz or by telephone on 921 9999 at extension 6902. Alternatively you may contact your AUTC Faculty Representative (a list with contact details may be found in the Ethics Knowledge Base at <http://www.aut.ac.nz/research/research-ethics/ethics>).

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

Yours sincerely

Dr Rosemary Godbold
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: Julia McPhee

From the desk of ...
Dr Rosemary Godbold
Executive Secretary
AUTC

Private Bag 92006, Auckland 1142
New Zealand
E-mail: ethics@aut.ac.nz

Tel: 64 9 921 9999
ext 8860
Fax: 64 9 921 9902
page 1 of 1

Appendix D. Ethics approval: Chapter 5



AUTEC
SECRETARIAT

19 September 2014

Grant Schofield
Faculty of Health and Environmental Sciences

Dear Grant

Re Ethics Application: **14/294 Developing practical and palatable guidelines for improving health and wellbeing.**

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

Your ethics application has been approved for three years until 19 September 2017.

As part of the ethics approval process, you are required to submit the following to AUTC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/researchethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 19 September 2017;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/researchethics>. This report is to be submitted either when the approval expires on 19 September 2017 or on completion of the project.

It is a condition of approval that AUTC is notified of any adverse events or if the research does not commence. AUTC 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 responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this. If your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply there.

To enable us to provide you with efficient service, please use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,

A handwritten signature in black ink, appearing to read 'K O'Connor'.

Kate O'Connor
Executive Secretary
Auckland University of Technology Ethics Committee

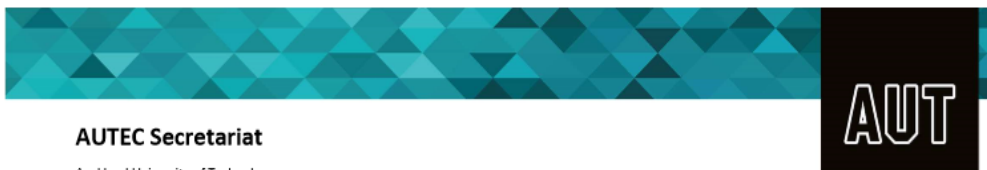
Cc: Kate White kate.white@aut.ac.nz

Auckland University of Technology Ethics Committee

WAS06F Level 6 WA Building City Campus

Private Bag 92008 Auckland 1142 Ph: +64-9-921-8888 ext 8218 email ethics@aut.ac.nz

Appendix E. Ethics approval: Chapters 7 and 8



AUTE Secretariat

Auckland University of Technology
D-89, W505F Level 5 WA Building City Campus
T: +64 9 921 9999 ext. 8316
E: ethics@aut.ac.nz
www.aut.ac.nz/researchethics

25 August 2015

Grant Schofield
Faculty of Health and Environmental Sciences

Dear Grant

Re Ethics Application: **15/263 Evaluating the feasibility of a wellbeing game.**

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

Your ethics application has been approved for three years until 24 August 2018.

As part of the ethics approval process, you are required to submit the following to AUTE:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/researchethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 24 August 2018;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/researchethics>. This report is to be submitted either when the approval expires on 24 August 2018 or on completion of the project.

It is a condition of approval that AUTE is notified of any adverse events or if the research does not commence. AUTE 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 responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTE grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this.

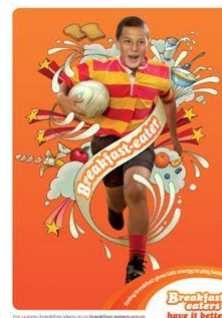
To enable us to provide you with efficient service, please use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,

Kate O'Connor
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: Kate Prendergast kate.white@aut.ac.nz, Lisa Mackay

Appendix F. Nutrition and physical activity dissemination messages



Appendix G. BE Well audit

Thinking about the past four weeks, use the scale to indicate how comfortable you feel with the amount of....			1= a lot less	2	3	4	5=about right	6	7	8	9= a lot more	Not applicable	
			1	2	3	4	↓	6	7	8	9	↓	
Eat. Aim to eat unprocessed foods such as vegetables, fruit, meat, fish and dairy													
1	...unprocessed foods (e.g. vegetables, fruit, meat, fish and dairy) you consume	Should consume a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should consume a lot more	<input type="checkbox"/>
2	...alcohol you consume	Should consume a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should consume a lot more	<input type="checkbox"/>
3	...sugar and processed foods you consume	Should consume a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should consume a lot more	<input type="checkbox"/>
Move more. Aim to move more, stand more, and sit less.													
4	...exercise you do	Should do a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should do a lot more	<input type="checkbox"/>
Sit less. Aim to sit less, stand more, and move more.													
5	...time you spend sitting	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
6	...time you spend on screen-based activities including iPads, TVs, computers	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
Sleep. Get a good night's sleep by focusing on quality (get outside during the day, avoid technology immediately before bed) and quantity.													
7	...sleep you get	Should get a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should get a lot more	<input type="checkbox"/>
8	...time you spend outdoors	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
Connect. Make time to connect with the people around you.													
9	...time you spend with your spouse / partner	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
10	...time you spend with your children	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
11	...time you spend with your parents	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
12	...time you spend with your friends	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
13	...time you spend with your colleagues	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>

Thinking about the past four weeks, use the scale to indicate how comfortable you feel with the amount of....			1= a lot less	2	3	4	5= about right	6	7	8	9= a lot more	Not applicable	
			1	2	3	4	↓	6	7	8	9	↓	
Give. Give time and attention to others.													
14	...time you spend doing things for others	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
15	...time you spend contributing to your household (e.g. household chores)	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
Slow down. Be mindful, live in the moment.													
16	...time you spend alone	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
17	...time you spend on rest and relaxation	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
18	...time you spend playing and having fun	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
Learn. Make time to learn new things.													
19	...time you spend on your hobbies and interests	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
Work and finance. Work-life balance and living within your means is important.													
20	...time you spend at work	Should spend a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should spend a lot more	<input type="checkbox"/>
21	...the amount you focus on money (financial) matters	Should focus a lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Should focus a lot more	<input type="checkbox"/>
Please use this space to specify any other areas of your lifestyle you would like to focus on (e.g. smoking).													
22	Click here to enter text.	A lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A lot more	<input type="checkbox"/>
23	Click here to enter text.	A lot less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A lot more	<input type="checkbox"/>

