

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

# EATS Study

---

*Eating Attributes of Tertiary Students and Potential  
Influencing Factors on Diet Quality*

A thesis presented in partial fulfilment of the requirements for the  
degree of

Master of Science in Nutrition and Dietetics

At Massey University, Auckland, New Zealand

Armand Panossian

2019

## Abstract

**Background:** In order to improve diet quality, it is important to assess its potential determinants. Literature indicates young adults attending university engage in unhealthy behaviour and may be at risk of establishing undesirable dietary habits that continue into later adulthood. An understanding of the dietary patterns and associated factors in this population is needed, particularly in New Zealand where the literature is sparse.

**Aims:** To investigate diet quality and potential influencing factors in a group of university in New Zealand.

**Methods:** Diet quality and associated factors were measured in a pilot sample of university students enrolled at Massey University's Albany Campus, Auckland, New Zealand. A self-administered online questionnaire was used to collect data on dietary habits as well as factors that have been associated with diet quality in previous research. A Diet index was developed and scored against the dietary recommendations outlined in the Eating and Activity Guidelines for New Zealand Adults.

**Results:** Forty university students were recruited in the study. The overall mean diet quality score was 54.2 ( $\pm 10.6$ ) points out of 80. The majority of participants met dietary guidelines for fruit (70%), vegetable (57.5%) and 'Extra' food intake (77.5%), while less than half of participants met dietary guidelines for grains (2.5%), wholegrains (30%), alcohol (40%), saturated fat (32.5%), added sugar (25%) and added salt (10%). Of the potential influencing factors investigated, healthy eating attitudes ( $P < 0.01$ ), binge drinking and use of dietary supplements ( $P \leq 0.04$ ), food preparation ( $P < 0.01$ ), as well as confidence in basic cooking techniques ( $P = 0.05$ ) were significantly associated with diet quality.

**Conclusions:** The current study identified potential influencing factors as well as components of the diet in this population that were below dietary recommendations, and findings suggest university students show clustering of health-related behaviours. This is particularly concerning given the evidence that university students lack the confidence and/or ability to prepare meals that contribute to optimal dietary habits, and are likely to engage in binge drinking; which was negatively associated with diet quality in the current study. Further research with improved methodology, specifically in regards to the diet quality index used, is needed to build on the findings in this study.

## **Acknowledgements**

To my Family; My Mum, Dad and Brother. Thank you for believing in me, for all the support that has been appreciated and taken for granted. Without you none of this would be possible and I am forever grateful.

Thank you Max, for always being eager to give me the opportunity to go for walks with you when I had spent far too long in my room.

Thank you to my fellow dietetic students for your support and wisdom, particularly those who helped me keep my sanity throughout the long hours in the library.

Thank you to my supervisors Dr. Jasmine Thomson and Dr. Janet Weber for their guidance and invaluable feedback. Your dedication to producing high quality research has developed my skills throughout this academic venture.

Thank you to Tracey and Gavin for all your support and kindness over the past few years, it's been much appreciated.

Finally, a very special thank you to my girlfriend Rachel Griffiths. Your love, patience, and encouragement throughout this challenging process has meant more than you know. Thank you for never giving up on me.

# Table of Contents

<b>Abstract</b> .....	<b>ii</b>
<b>Acknowledgements</b> .....	<b>iii</b>
<b>Table of Contents</b> .....	<b>iv</b>
<b>List of Figures</b> .....	<b>vi</b>
<b>List of Tables</b> .....	<b>7</b>
<b>List of Abbreviations</b> .....	<b>8</b>
<b>1 Introduction</b> .....	<b>9</b>
1.1 Background .....	9
1.1.1 Dietary habits of university students.....	9
1.1.2 Measurement of diet quality .....	10
1.1.3 Influences on diet quality .....	10
1.2 Aims and Objectives .....	11
1.2.1 Aims .....	11
1.2.2 Objectives .....	11
1.2.3 Hypothesis.....	11
1.3 Thesis structure .....	12
1.4 Contributors to the research .....	12
<b>2 Literature Review</b> .....	<b>13</b>
2.1 University students' nutrition issues .....	13
2.2 Diet and nutrient intake measurement in university studies .....	14
2.3 Diet indices .....	16
2.4 Determinants of diet quality in university students.....	21
2.4.1 Gender.....	21
2.4.2 Living situation .....	22
2.4.3 Risky and health promoting behaviours.....	23
2.4.4 Food sources .....	24
2.4.5 Food preparation ability .....	26
2.4.6 Food and nutrition knowledge .....	26
2.4.7 Food insecurity.....	27
2.5 Current state of knowledge in New Zealand and purpose of proposed study.....	28
<b>3 Manuscript</b> .....	<b>29</b>
3.1 Introduction .....	30
3.2 Materials and Methods.....	31

3.3	Results.....	32
3.4	Discussion .....	37
3.5	Conclusions.....	41
3.6	References .....	41
<b>4</b>	<b>Conclusions and Recommendations .....</b>	<b>45</b>
4.1	Overview and conclusions .....	45
4.2	Strengths of current research.....	46
4.3	Limitations of research.....	46
4.4	Recommendations for future research .....	47
	<b>References.....</b>	<b>49</b>
<b>5</b>	<b>Appendices.....</b>	<b>57</b>
	Appendix A: EATS Questionnaire .....	57
	Appendix B: Scoring of Dietary Guideline Index.....	77
	Appendix C: Supplementary Results .....	82

## List of Figures

Figure 3.1 Proportion of sample attaining maximum score for each diet quality score component, representative of EAGNZ and Recommended dietary intakes for Australia and New Zealand..... 33

Figure 3.2 Mean diet quality score for each component for all participants standardised to 100% ..... 34

## List of Tables

Table 1.1 Researchers' contribution to the study .....	12
Table 2.1 Components and scoring methods of the revised Dietary Guideline Index (DGI) score used for Australian adults (Thorpe et al., 2016).....	19
Table 3.1 Key characteristics of a sample of university students .....	32
Table 3.2 Potential influencing factors compared to mean diet quality scores.....	34



## List of Abbreviations

NZ	New Zealand
US	United States
UK	United Kingdom
DI	Diet index/indices
EAGNZ	Eating and activity guidelines for New Zealand adults
DGI	Dietary Guideline Index
NCD	Non-communicable disease
DQI	Diet Quality Index
HEI	Healthy Eating Index
HDI	Healthy Diet Indicator
MDS	Mediterranean Diet Score
PCA	Principal component analysis
FA	Factor analysis
CA	Cluster analysis
NZDQI-A	New Zealand Diet Quality Index for Adolescents
AGHE	Australian Guide to Healthy Eating

# **1 Introduction**

## **1.1 Background**

Nutrition related risk factors such as harmful levels of alcohol consumption and poor diet quality have been shown to play an important role in the development of non-communicable diseases (NCD), which account for 63% of global mortality (Marrero, Bloom, & Adashi, 2012). Furthermore, approximately 40% of deaths in New Zealand can be attributed to nutrition-related risk factors (Stefanogiannis et al., 2005). In order to improve diet quality, it is important to assess its potential determinants, particularly in populations that have been shown to be at higher risk of having poor diet quality compared to the general population.

### **1.1.1 Dietary habits of university students**

Young adulthood represents a critical transition period, and there is evidence to show a drop in diet quality as dietary intake patterns respond to life course events such as leaving school, moving away from home and beginning higher education (Craigie, Mathers, Rugg-Gunn, & Adamson, 2004; Forshee & Storey, 2006). There is considerable amount of literature on the dietary and health behaviours of young adults at university. The evidence points towards this population engaging in unhealthy behaviours such as high consumption of fast foods (El Ansari, Stock, & Mikolajczyk, 2012; Tanton, Dodd, Woodfield, & Mabhala, 2015), high consumption of snack foods (El Ansari et al., 2012; Sprake et al., 2018; Wansink, Cao, Saini, Shimizu, & Just, 2013), excessive alcohol consumption (El Ansari et al., 2011; Nelson, Lust, Story, & Ehlinger, 2009), and insufficient fruit and vegetable intake (El Ansari et al., 2012; Small, Bailey-Davis, Morgan, & Maggs, 2013). While Hartman, Wadsworth, Penny, van Assema, and Page (2013) investigated psychosocial determinants of fruit and vegetable intake, the last study to investigate overall dietary habits in New Zealand University students was in 1991; Horwath et al. evaluated nutrient intakes from 3-day diet records of undergraduate students in Dunedin and compared them to the 1983 Recommendations for Selected Nutrient Intakes of New Zealanders (NZRs) and the 1989 US Recommended Daily Allowances (US RDAs) (Horwath, 1991). Although these findings are important to reflect on, with the change in the environment and culture of New Zealand since 1991, as well as the change in nutrition recommendations, these results may no longer represent the dietary intake of current university students.

A better understanding of the factors associated with the undesirable dietary behaviours observed in university student populations is needed, particularly in New Zealand, where the few studies that have investigated this topic have indicated concern for the dietary behaviours in this population (Hartman et al., 2013; Horwath, 1991).

### **1.1.2 Measurement of diet quality**

Since people do not eat foods or nutrients in isolation; interest has grown in the interactions of whole foods and whole diets as opposed to individual nutrients in population groups that are at high risk of having poor diet quality, such as university students (Darnton-Hill, Nishida, & James, 2004; Papadaki, Hondros, Scott, & Kapsokefalou, 2007). This has led to the development of diet indices (DIs) or scores, that are based on national dietary guidelines which reflect existing knowledge of optimal dietary practices in each respective country. DIs are essentially a scoring system, interpreting data gathered on dietary behaviours such as fruit and vegetable intake and salt intake, and the like, into a score that demonstrates adherence of a population to national dietary guidelines.

Western-type diet DIs have been validated in studies on young adult populations in the US and Canada (Boggs, Rosenberg, Rodríguez-Bernal, & Palmer, 2013; Erin et al., 2019; Strawson et al., 2013), as well as university student populations in Australia (Kourouniotis et al., 2016; Thorpe, Kestin, Riddell, Keast, & McNaughton, 2014; Wiltgren et al., 2015). Furthermore, Thorpe and colleagues (2014) found DI scores were related to dietary behaviours such as cooking ability and frequency of convenience meal consumption (Thorpe et al., 2014). Thorpe and colleagues have used their DI called the Dietary Guideline Index (DGI) which is based on the Dietary Guidelines for Australian Adults, in a number of Australian populations, including university students. Therefore, because the university student culture is similar to New Zealand, in the proposed study the aim was to develop a similar DI; and take a similar approach but instead use the Eating and Activity Guidelines for New Zealand Adults (EAGNZ) to develop a score to assess the diet of New Zealand university students (Ministry of Health, 2015).

### **1.1.3 Influences on diet quality**

A range of factors have been associated with diet quality of university students in Western societies; ranging from risky behaviours such as binge drinking (Nelson et al., 2009) to environmental factors such as living situation (Laska, Larson, Neumark-Sztainer, & Story, 2010; Small et al., 2013). However; research on the diet quality of university students in New

Zealand is sparse (Hartman et al., 2013; Horwath, 1991). Hartman et al. (2013) assessed the psychosocial determinants of fruit and vegetable intake of university students in Wellington. Hartman and colleagues found taste, health awareness/knowledge, and the social influence of flatmates and partners to be important determinants of fruit and vegetable intake. However, no other potential determinants of diet quality were investigated. These authors concluded that more research is required given the unique lifestyle found in their sample of university students compared to other young adults.

Therefore, in the current study, we seek to evaluate the diet quality of a group of university students using a DI that reflects the EAGNZ and to investigate potential influencing factors.

## **1.2 Aims and Objectives**

### **1.2.1 Aims**

To investigate the relationship between diet quality and influencing factors in a group of university students enrolled at Massey University, Albany, Auckland, New Zealand.

### **1.2.2 Objectives**

The aim will be accomplished by the following research objectives:

- Assess the extent to which a sample of university students comply with dietary guidelines in New Zealand
- Assess the relationship between diet quality and potential influencing factors

### **1.2.3 Hypothesis**

Based on current literature in the area, we predict that the following factors will have a significant relationship with diet quality:

- Gender
- Living situation
- Risky and health promoting behaviours
- Food sources
- Food preparation ability
- Food and nutrition knowledge

- Food security

### 1.3 Thesis structure

This thesis has been structured into four chapters. Chapter 1 provides an introduction and overview of the study topic. Chapter 2 is a literature review, covering all the relevant and pertinent literature associated with the background, methods, and justification of the current study. Chapter 3 is a research manuscript, presenting the results of the study for submission to the journal *Nutrients*. Chapter 4 provides an overview and final conclusions of the research, along with strengths, limitations and recommendations for future research.

### 1.4 Contributors to the research

**Table 1.1** Researchers' contribution to the study

Contributors	Research Contribution
Armand Panossian	Principal Researcher – Thesis Author  Recruitment of participants, data collection, data analysis, results and discussion formulation, preparation of thesis manuscript
Dr. Jasmine Thomson	Academic Supervisor  Provided supervision throughout study; including the design and conduct of study, ethics application, and supervised writing of thesis
Dr. Janet Weber	Academic Supervisor  Provided supervision throughout study; including the design and conduct of study, ethics application, and supervised writing of thesis

## **2 Literature Review**

### **2.1 University students' nutrition issues**

Non-communicable diseases (NCDs) account for 63% of global mortality. Nutrition risk factors are the same in New Zealand as for Western cultures and include harmful levels of alcohol consumption, and poor diet quality (Marrero et al., 2012). Diets do not remain static or fixed; they evolve over time and are influenced by many factors. Individual preferences and beliefs, socioeconomic status, cultural traditions and environmental factors interact in a complex manner to shape dietary quality. There is evidence to indicate diet quality generally increases with age (Thiele, Mensink, & Beitz, 2004); however, there is also evidence showing a drop in diet quality during the transition period from adolescence to adulthood (Forshee & Storey, 2006). The majority of studies on the diet quality of young adults or university students have been cross-sectional in design, which gives limited insight into changes or developments of dietary habits over time; however research conducted by Craigie et al. (2004) showed how diets evolved through a 21-year period. They pointed out that dietary intakes respond to life course events such as leaving school, moving away from home and beginning higher education; these findings support previous research from Edwards and Meiselman (2003), who report considerable changes in nutrient intake over the first year of university study.

A considerable amount of literature has been published on the nutrition and health behaviours of university students in Western cultures, with increasing concern that this population often engages in unhealthy behaviours such as high consumption of fast foods (El Ansari et al., 2012; Tanton et al., 2015), high consumption of snack foods (El Ansari et al., 2012; Sprake et al., 2018; Wansink et al., 2013), excessive alcohol consumption (El Ansari et al., 2011; Nelson et al., 2009) and insufficient fruit and vegetable intake (El Ansari et al., 2012; Small et al., 2013). It is not surprising to find evidence of weight gain in university students over their university career (Gropper, Simmons, Connell, & Ulrich, 2012). This is of particular concern considering the likelihood that being overweight or obese in young adulthood will persist in later adulthood (Guo et al., 2000).

Given the association between poor diet quality and NCDs (Marrero et al., 2012), gaining a better understanding of factors affecting University students' diet quality will help identify and address poor dietary habits during an important transitional period. However, before exploring potential determinants of University students' diet quality, it is important to review how dietary habits and behaviours have been investigated in the past.

## **2.2 Diet and nutrient intake measurement in university studies**

Previous research has often used individual diet diaries, food frequency questionnaires and diet histories to collect food consumption data either prospectively or retrospectively to capture usual intakes of individuals and groups. Various methods have been developed to assess this dietary data in relation to health or disease outcomes. Traditionally, nutrition research has focussed on the effects of individual food components or single nutrients in the diet (Beerman, Jennings, & Crawford, 1990; Horwath, 1991; Wardle & Steptoe, 1991). However, questions have since been raised over studies lacking insight into the interactions of nutrients and non-nutrients in relation to health effects and chronic disease. The focus on saturated fat and CVD risk over the past few decades is one example. Saturated fat intake was widely accepted to be a contributing factor to CVD, but more recent research has highlighted that the relationship between nutrient and disease may not be so simple; including reports of saturated fat from dairy foods not being associated with CVD risk (Chen et al., 2016), and that decreasing saturated fat did not affect CVD risk when carbohydrate intake, particularly from refined sugars, replaced saturated fat in the diet (DiNicolantonio, Lucan, & O'Keefe, 2016).

These observations have led to a shift in focus from individual components of the diet to include the food matrix in which nutrients are found and overall patterns in the diet. People do not consume nutrients alone, or single food components; they consume foods in the form of various meal patterns. Studying the effects of single dietary components cannot capture the complex interactions of the foods consumed, and therefore a more holistic approach to nutrition research has been developed in the form of dietary patterning (Jacques & Tucker, 2001). Various methods of dietary pattern analysis have been developed and can be separated into *a priori* and *a posteriori* approaches.

In *a priori* or hypothesis-driven approaches, pre-defined scores or indices (DIs) are used to express the overall diet quality of a population. These scores are developed and defined using pre-existing dietary guidelines for the general population or for the prevention of diet related

health conditions. Scores can also be based on dietary patterns that are known to be healthy, such as the Mediterranean diet (Waijers, Feskens, & Ocké, 2007). Once the components to be included in the index have been selected, they are quantified and scored accordingly; a score of '0' is given for a component if consumption is lower than recommended, or higher than recommended if the component is an unfavourable dietary behaviour. A maximum score ranging from 1 to 10 is given for a component if the dietary recommendation is met. The scores for each component or guideline are summed to produce an overall score reflecting adherence to dietary recommendations.

Widely used DIs include the Healthy Eating Index (HEI), the Dietary Quality index, the Healthy Diet Indicator (HDI), and the Mediterranean Diet Score (MDS) (Guerrero & Perez-Rodriguez, 2017). More detail on DIs are given in the next section. But suffice to say, these indices can be revised to reflect the current recommendations, and adaptations allow them to meet specific research purposes and cultural differences among different populations.

The decisions that need to be considered by researchers when devising a diet quality index include which variables to include and how to score the included items. The subjectivity introduced when making these decisions has been identified as a concern for the methods validity (Moeller et al., 2007). Despite this, DI scores have been shown to be a useful tool in monitoring the adherence to dietary guidelines in a variety of populations, including university student populations in the US, UK, other areas of Europe and Australia (Arroyo et al., 2006; Cooke & Papadaki, 2014; Laska, Pasch, Lust, Story, & Ehlinger, 2011; Thorpe et al., 2014).

Diet quality scores are easy to compute and therefore can be easily reproduced to compare results between and within populations, whereas *a posteriori* approaches are population and data specific, making it difficult to compare. Another advantage of using DIs over *a posteriori* approaches, as pointed out by McNaughton, Ball, Crawford, and Mishra (2008) in their rationale behind developing a DI for the Australian population, is that DIs provide a clear nutritional benchmark and consequently may be more easily understood by the public. This is important when translating findings to the general public, as well as other academics who may be interested in the topic of diet quality.

In contrast to *a priori* approaches, *a posteriori* approaches are data driven and dietary patterns are defined by using statistical analysis after the dietary data has been collected. Statistical analysis methods that fall under this category include principal component analysis (PCA), factor (FA) and cluster analysis (CA). In contrast to dietary indices, these approaches are data



driven and are defined by using statistical analysis once the dietary data has been collected. PCA and FA are similar in the sense that both analyses are statistical data reduction tools originally developed in social sciences (Wirfält, Drake, & Wallström, 2013). CA is useful for gaining an insight into the different dietary patterns within a population by grouping participants into different clusters that are mutually exclusive (Michels & Schulze, 2005). Individuals within clusters share a similar dietary pattern, and individuals in other clusters have food patterns that are different (Ocké, 2013).

*A posteriori* methods of dietary pattern analysis, particularly FA and CA, have been used in university student populations in the United States (US) and United Kingdom (UK) in recent years (Dodd, Al-Nakeeb, Nevill, & Forshaw, 2010; Greene et al., 2011; Sprake et al., 2018). Tucker (2010) explains that these multivariate methods are most useful for designing nutrition interventions for a specific population. However, it is important to note that while *a posteriori* approaches explain the variation in dietary intake in a population, they lack the ability to provide data on other areas of the diet which make up the overall diet in a population. Therefore, the variations only highlight a few characteristics of a person's diet which may overshadow or disregard other components that make up the overall diet. Additionally, the characteristics identified may not be related to health outcomes (Schulze & Hoffmann, 2006). In contrast, dietary indices are primarily used to measure overall adherence to dietary guidelines; which are generally developed by experts in human nutrition who assess the most up to date evidence for chronic disease prevention in Western societies. The different approaches to dietary pattern analysis are considered to be complimentary to each other to provide answers to specific aims and objectives of different research (Ocké, 2013). Given the advantages and disadvantages discussed, and that the proposed research is hypothesis-driven, it would appear DIs would be the best suited methodology for the current study.

### **2.3 Diet indices**

DIs are a scoring system that measure the extent to which individuals meet predefined diet and/or nutrient recommendations based on current knowledge of dietary factors associated with reduced NCD risk (Hu, 2002). The first DI was developed in 1994 by Patterson, Haines, and Popkin (1994), called the Diet Quality Index (DQI) and has since seen a rapid development of tailored or adapted DIs for specific research purposes and populations. The following will review the most relevant DIs and their use in past studies.

Commonly used DIs used in nutritional research, are the Dietary Quality Index (DQI), the Healthy Eating Index (HEI), Healthy Diet Indicator (HDI), and the Mediterranean Diet Score (MDS). The Dietary Quality Index, HEI, and HDI are similar in that they all contain a method of quantifying dietary variety, a measure of some individual nutrients and food groups compared to dietary guidelines, and an overall balance of macronutrients (Gil, Martinez de Victoria, & Olza, 2015). The largest disparity between these indices is in the way fat intake is measured (Guerrero & Perez-Rodriguez, 2017). The MDS is dissimilar to the other three indices; it is made of eight components which measure features of the Mediterranean diet shown to protect against CVD and major chronic degenerative diseases, particularly in Greek and other Mediterranean populations (Serra-Majem, Bach, & Roman, 2006; Sofi, Cesari, Abbate, Gensini, & Casini, 2008).

Different DIs focus on different combinations of dietary fat; including total fat, cholesterol, saturated fats, trans fats, monounsaturated fats, and polyunsaturated fats. In summary, the variety of DIs available cover most aspects of the diet and are a useful tool for measuring adherence to particular dietary guidelines. Choosing one over the other is dependent on the target populations' characteristics and respective national dietary guidelines, as evidenced by the Dietary Guideline Index (DGI) used by Thorpe et al. (2014). This DI was developed using the dietary recommendations in the Australian Guide to Healthy Eating (AGHE) (The Children's Health Development Foundation & Deakin University, 1998).

Nutritional research on university students is far less extensive than on that of other young adult populations. DIs have been used to measure nutritional status of young adults more than that of university students, and primarily in the US (Boggs et al., 2013; Deshmukh-Taskar, Radcliffe, Liu, & Nicklas, 2010) and Canada (Erin et al., 2019; Strawson et al., 2013). These studies on young adults used either the original HEI or a variation of it, while Murakami and Livingstone (2016) used both the HDI and MDS to measure diet quality in their sample. Interestingly, they found both the HDI and MDS scores were inversely associated with the energy density of meals and snacks reported in the diet histories of participants. The potential similarities in resulting DI scores between different DI methods provide reason to compare findings across different studies irrespective of the DI method chosen. DI scores have been validated against other diet quality measures such as 24-hour diet recalls (McNaughton, Ball, Crawford, & Mishra, 2008; Vyncke et al., 2013), and have been shown to be a good representation of adherence to dietary guidelines in both young adult (Smith et al., 2017) and university student populations (Kourouniotis et al., 2016; Thorpe et al., 2014; Wiltgren et al.,

2015). Additionally, DI scores such as the ones produced from the Dietary Guideline Index (DGI) specific to the Australian nutrition guidelines (Table 1), has been associated with food-related behaviours such as cooking meals for oneself and frequency of takeaway/convenience meal consumption (Thorpe et al., 2014).

To date, research on young adults and university students in New Zealand have focused on fruit and vegetables (Hartman et al., 2013) and individual nutrient intake (Horwath, 1991). Currently, there is no simple food-based diet index that has been used for examination of diet quality in New Zealand adults. However, the use of a DI scoring system has shown promise in adolescents. Wong et al. (2015) developed the New Zealand Diet Quality Index for Adolescents (NZDQI-A), and high NZDQI-A scores were found to be significantly associated with lower body fat.

Australia and New Zealand share similar cultures as well as nutrient recommendations (Commonwealth Department of Health and Ageing Australia, New Zealand Ministry of Health, & National Health and Medical Research Council, 2006). The DGI used by Thorpe et al. (2014), was originally developed using these recommendations as well as the Australian Guide to Healthy Eating (AGHE) (The Children's Health Development Foundation & Deakin University, 1998). The revised edition used in 2016 (Table 2.1) was adapted according to the Australian Dietary Guidelines (National Health and Medical Research Council, 2013; Thorpe, Milte, Crawford, & McNaughton, 2016). Similar to the Eating and Activity Guidelines for New Zealand Adults (EAGNZ) (Ministry of Health, 2015), the AGHE was developed as a guide for the general public to aid in healthier dietary choices. The AGHE covers recommended dietary intakes for the five core food groups; including vegetables, fruits, cereals (grains), meat and alternatives, and dairy. The AGHE are presented differently but cover very similar dietary recommendations in the same level of detail as the EAGNZ. In the EAGNZ, there is increased emphasis on lowering alcohol intake and improving the variety of lean protein sources consumed compared to the AGHE.

An important consideration in the use of DIs is how dietary intakes are measured. 24-hour dietary recalls, dietary histories and food frequency questionnaires (FFQ) are valid methods to estimate dietary intakes. 24-hour dietary recalls provide detailed intake data for one day and diet histories provide data on usual dietary intake estimates over a relatively long period, they both require a trained interviewer and tend to be time-consuming to implement and analyse. Of the three methods, self-administered FFQs are most prone to recall bias as they lack

guidance from a trained interviewer, however if well developed, they provide a cost-effective and practical way to measure dietary intakes without a large burden on time (Shim, Oh, & Kim, 2014). Previous literature utilising a DI to measure diet quality have most often used a FFQ (Boggs et al., 2013; Thorpe et al., 2014) or a 24-hour recall method (Deshmukh-Taskar et al., 2010; Erin et al., 2019) to collect data on dietary intake.

**Table 2.1** Components and scoring methods of the revised Dietary Guideline Index (DGI) score used for Australian adults (Thorpe et al., 2016)

Dietary Guideline	Indicator and Description	Criteria for Maximum Score <sup>1</sup>	Criteria for Minimum Score	Maximum Score
Guidelines for adequate intake				
1. Enjoy a wide variety of nutritious foods	Food variety <sup>2</sup> : proportion of food from each of the 5 core food groups eaten at least one serve per week	100%	0%	10
2. Plenty of vegetables	Total vegetable intake: servings of vegetables per day	19–50 y: M ≥ 6, F ≥ 5 51–70 y: M ≥ 5.5, F ≥ 5 > 70 y: M ≥ 5, F ≥ 5	0	10
3. Fruit	Total fruit intake: servings of fruit per day	≥2	0	10
4. Grain (cereal) foods	Total cereal intake: servings of grains per day	19–50 y: M ≥ 6, F ≥ 6 51–70 y: M ≥ 6, F ≥ 4 >70 y: M ≥ 4.5, F ≥ 3	0	5
	Mostly wholegrain or high fiber cereals: Type of bread usually consumed	Wholemeal bread	White bread	5
5. Lean meat and poultry, fish, eggs, nuts and seeds, and legumes/beans	Total meat and alternative: servings per day	19–50 y: M ≥ 3, F ≥ 2.5 51–70 y: M ≥ 2.5, F ≥ 2 >70 y: M ≥ 2.5, F ≥ 2	0	5
	Lean meat: proportion of lean meats and alternatives to total meat and alternatives per day	100%	0%	5

6. Milk, yoghurt, cheese and/or their alternatives <sup>3</sup>	Total dairy and alternative: servings per day	19–50 y: M $\geq$ 2.5, F $\geq$ 2.5 51–70 y: M $\geq$ 2.5, F $\geq$ 4 >70 y: M $\geq$ 3.5, F $\geq$ 4	0	10
7. Drink plenty of water	Total beverage intake <sup>4</sup> : servings per day	M $\geq$ 10; F $\geq$ 8	0	5
	Water <sup>5</sup> : proportion of water to total beverage intake per day	$\geq$ 50%	0%	5
<b>Guidelines to limit or moderate intake</b>				
8. Limit intake of foods containing saturated fat, added salt, added sugars and alcohol	Limit discretionary foods	M $\leq$ 3; F $\leq$ 2.5	M > 3; F > 2.5	10
9. Limit intake of foods high in saturated fat	Trim meat: trimming fat from meat	Usually	Never or rarely	5
	Choose reduced-fat milk: type of milk usually consumed	Skim, low or reduced fat milk	Whole milk	5
10. Small allowance of unsaturated oils, fats or spreads	Unsaturated spreads and oils: servings per day	19–50 y: M $\leq$ 4, F $\leq$ 2 51–70 y: M $\leq$ 4, F $\leq$ 2 >70 y: M $\leq$ 2, F $\leq$ 2	M > 4; F > 2	10
11. Limit intake of foods and drinks containing added salt	Salt use: salt added during cooking	Never or rarely	Usually	5
	Salt use: salt added during the meal	Never or rarely	Usually	5
12. Limit intake of foods and drinks containing added sugars	Limit extra sugar <sup>6</sup> : servings per day	M $\leq$ 1.5; F $\leq$ 1.25	M > 1.5; F > 1.25	10
13. If you choose to drink alcohol, limit intake	Limit alcohol: servings per day	$\leq$ 2	>2	10

1: Criteria for maximum scores were derived from the Australian Dietary Guidelines unless otherwise noted; y: years; M: Male; F: Female; 2: Food variety was measured and scored using a similar method to the Recommended Food Score; 3: Choosing reduced fat dairy is captured in the “Limit intake of foods high in saturated fat” component; 4: The Eat for Health Australian Dietary Guidelines do not have specific recommendations for beverage consumption and recommended the guidelines found in the Nutrient Reference

Values for Australia and New Zealand; 5: The proportion of water to total beverage intake was derived from US beverage guidelines; 6: Since added sugar intake is not recommended there are no cut-off values for the number of recommended servings, instead half of the maximum discretionary food cut-off were used consistent with the original DGI.

## **2.4 Determinants of diet quality in university students**

Diets evolve over time and are influenced by many factors and complex interactions that may have a positive or negative impact on the overall diet quality of an individual or population. There is evidence of a decrease in diet quality during attendance at university (El Ansari et al., 2012; Small et al., 2013; Sprake et al., 2018). Therefore, it is important to investigate the determinants of diet quality in this population. What follows is a summary of the literature addressing factors associated with and potentially influencing the diet quality of young adult and university student populations to date.

### **2.4.1 Gender**

Research in young adult populations in recent years has highlighted gender as an influential factor in the dietary behaviours, with studies reporting that men are more likely to engage in unhealthy dietary behaviours, such as binge drinking and takeaway food consumption, than women (El Ansari et al., 2011; Olson, Hummer, & Harris, 2017; Papier, Ahmed, Lee, & Wiseman, 2015; Smith et al., 2009). This is supported by Sprake et al. (2018) who identified significant differences in dietary behaviours of UK men and women university students. Compared to women, men reported consuming more red meat, alcohol, and convenience foods such as processed meats, fried food, ready-made sauces, pizza, and chips. Women have consistently been shown to place more importance on health-related behaviours such as their diet than men (Li et al., 2012; Morse & Driskell, 2009), with more attention focused on the nutritional content of food to avoid refined sugars, fat and salt (Tam, Yassa, Parker, O'Connor, & Allman-Farinelli, 2017). Furthermore, women are reported to have more confidence in their ability to prepare food compared to their male counterparts (Wilson, Matthews, Seabrook, & Dworatzek, 2017). A longitudinal study in New Zealand by Utter, Larson, Laska, Winkler, and Neumark-Sztainer (2018) found that adequate cooking skills in 18 to 23 year olds was associated with improved dietary behaviours 10 years later, including more frequent preparation of meals with vegetables and less frequent fast food consumption.

Currently, there is no research on gender difference in diet quality of New Zealand university students. However, research on the adult population has found women consume less alcohol and more fruits and vegetables than men (Ministry of Health, 2019). In a recent study, being a women was associated with a healthy dietary pattern characterised by low intakes of pies, potato chips, takeaway foods, soft drinks and alcohol (Beck et al., 2018).

#### **2.4.2 Living situation**

University students may find themselves residing in either on-campus dormitory halls or off-campus locations during their university careers. Off-campus locations include houses or apartments where students live independently from their parents, as well as family homes where students are still living with their parents (Small et al., 2013). Moving out of the family home into off-campus houses or apartments or on-campus dormitory halls is a life changing experience that often takes place during late adolescence or young adulthood, and often coincides with tertiary study. There is evidence that the living situation of university students may affect their diet quality (Morrell, Lofgren, Burke, & Reilly, 2012).

Studies in the US have found that students who live independently off-campus consume less fruits and vegetables, less variety of grains, are more likely to be overweight or obese, and consume more alcohol than those who live on-campus or off-campus with their parents (Brunt & Rhee, 2008; Laska et al., 2010; Small et al., 2013). El Ansari et al. (2012) showed similar findings, with those living off-campus in their family homes consuming more fruits and vegetables than those living outside of their family home in Germany, Denmark, Poland, and Bulgaria. Harker, Sharma, Harker, and Reinhard (2010) also observed more fruit and vegetable intake in those still living at home in Germany.

Students who live on-campus may also be at less risk of unfavourable dietary behaviours compared to those living independently off-campus. The structured meal plan or other food service options that are often available on university campuses for halls of residents provides students with access to cooked meals (Brown, Dresen, & Eggett, 2005). This may compensate for the lack of cooking or meal preparation skills observed in university students (Larson, Perry, Story, & Neumark-Sztainer, 2006), and minimise the likelihood of takeaway and convenience meal consumption.

### **2.4.3 Risky and health promoting behaviours**

Keller, Maddock, Hannoever, Thyrian, and Basler (2008) suggest that the freedom young adults explore when they enter university is an underlying factor for behaviours that reflect poor health outcomes, or 'risky behaviours'. These behaviours include irregular meal patterns, consumption of takeaway foods and binge drinking.

Binge drinking has been associated with poorer diet quality among adults (Breslow, Guenther, & Smothers, 2006), and long-term heavy alcohol consumption has been shown to lead to adverse health outcomes such as liver cirrhosis and brain damage (Room, Babor, & Rehm, 2005). Internationally, there is a large body of evidence indicating binge drinking is intrinsic to university culture, with recent studies in the US, UK, and Germany finding that binge drinking is prevalent among their university student population (Dodd et al., 2010; El Ansari et al., 2011; Keller et al., 2008; Nelson et al., 2009). The alcohol advisory council of New Zealand reported that tertiary students exhibit the highest prevalence of binge drinking in New Zealand. Alarmingly, men aged 18 to 19 showed the riskiest drinking behaviours. These high rates have been attributed to the importance placed on the opinion of peers and the student culture, coming of age, and the promotion of alcohol to tertiary students (Towl & Alcohol Advisory Council of New Zealand, 2004).

In contrast to the risky behaviours found in university students, there is also evidence of intentions to promote health in the form of dietary supplement use among young adult and university student populations. Dietary supplements cover a range of products now available to the public and can include multivitamin and mineral, single vitamins, single minerals, herbal supplements, oil supplements and sport supplements (Radimer et al., 2004). Lieberman et al, (2015) assessed the prevalence of supplement use among university students in the US, defined in their study as using a supplement at least once a week for the past six months, and found 66% reported taking supplements. Lieberman and colleagues (2015) concluded that college students are more likely to use dietary supplements than the general population. Wiltgren (2015) and colleagues defined supplement use in their study as anyone who reported using a supplement as frequently as once a month over the past month, and also found a high prevalence (56%) in Australian university students. Supplement intake is likely to have changed in New Zealand since 1991; the only time supplement intake was investigated among university students in New Zealand, where 7% of men and 16% of women reported taking a supplement once a week (Horwath, 1991), particularly given the shift in dietary patterns found



from comparing the 1997 and 2008/09 National Nutrition Survey (Smith, Gray, Mainvil, Fleming, & Parnell, 2015).

Wiltgren et al. (2015) assessed the relationship supplement use has with diet quality and found supplement use was significantly associated with higher diet quality scores. More recent investigations into the relationship of supplement use with diet quality, although carried out on young adult populations and not specifically university students, have found similar results (Anders & Schroeter, 2017; Blumberg, Frei, Fulgoni, Weaver, & Zeisel, 2017; Kuczmarski et al., 2017). Supplement use is significantly associated with either improved diet quality scores, nutrient intake, or desirable dietary behaviours. The most common reason for university students taking supplements reported by Lieberman et al (2015) was for promotion of general health. Other reasons included providing more energy, muscle strength and enhancing general performance. It is not clear whether general performance referred to academic or sporting performance, or a combination of both.

Studies have also explored health promoting behaviours such as physical activity levels of university students (Kasperek, Corwin, Valois, Sargent, & Morris, 2008; Morrow et al., 2006). Researchers in the US and UK have observed low levels of physical activity and poor diet quality in university students (Racette, Deusinger, Strube, Highstein, & Deusinger, 2008; Serlachius, Hamer, & Wardle, 2007). Researchers in Belgium investigated the changes in health behaviours of high school students during their transition to university study. Interestingly, they observed a drop in physical activity in conjunction with a drop in dietary variety and an increase in alcohol consumption (Deforche, Van Dyck, Deliens, & De Bourdeaudhuij, 2015). The most recent research, in the Netherlands and the UK van den Bogerd, Maas, Seidell, and Dijkstra (2018) found fruit and vegetable consumption was lower among students who were not meeting physical activity guidelines, and Sprake et al. (2018), found low physical activity was positively associated with less healthful dietary patterns.

#### **2.4.4 Food sources**

The diet quality of university students may also be affected by their food environment, which can be defined as the amount, type and accessibility of food outlets as well as the availability, cost, quality, and promotion of food and beverage products (Glanz, Sallis, Saelens, & Frank, 2005). Food environments consist of numerous components, however specific aspects such as

exposure to fast food outlets have been shown to be a major determinant of energy intake and weight gain in adult populations (Burgoine, Sarkar, Webster, & Monsivais, 2018).

Recent studies on the food environments of university campus' in Australia have highlighted the poor quality of foods and beverages available in the vending machines and surrounding food outlets. Outside of structured meal plans in dining halls for students living on campus, there was a high proportion of energy-dense and nutrient-poor foods on offer (Grech, Hebden, Roy, & Allman-Farinelli, 2017; Ng, Sangster, & Priestly, 2019; Shi, Colagiuri, Wang, Norman, & Allman-Farinelli, 2018). Similar findings have been observed in New Zealand, with Roy et al. (2017) conducting a cross-sectional survey across six university campuses and finding students with higher diet quality scores consumed significantly less university campus foods. Roy, Soo, Conroy, Wall, and Swinburn (2019) also conducted a more recent study to investigate the food purchasing behaviours and preferences of university students across six university campuses, and found the majority of their sample (79%) purchased food and beverages on campus. Additionally, they reported that healthy food products were less available, accessible, and cost more than unhealthy items. Tam (2017) and colleagues found 93% of students at an Australian university reported sometimes purchasing food or beverages on campus. Research into the determinants of food and beverage choice of university students in the US and Belgium have revealed convenience and cost as major contributors (Deliens, Clarys, De Bourdeaudhuij, & Deforche, 2014; Greaney et al., 2009).

The past decade has seen a range of environmental interventions in tertiary settings to improve food environments and investigate effects of the improvements on nutrition outcomes in university students. Numerous researchers have reported positive improvements in nutrition intake in response to interventions such as nutrition labelling of foods and beverages (Chu, Frongillo, Jones, & Kaye, 2009; Driskell, Schake, & Detter, 2008; Nikolaou, Hankey, & Lean, 2014), point of purchase promotional messages (Freedman & Connors, 2011; Peterson, Duncan, Null, Roth, & Gill, 2010) and reduced portion sizes in university dining halls (Freedman & Brochado, 2010; Stroebele, Ogden, & Hill, 2009). The research discussed in this section highlight the importance of food environment and where students source their food in relation to diet quality. Therefore, it may be useful to investigate the food and beverage purchasing behaviours of students in future studies as it may explain variations in diet quality.

#### **2.4.5 Food preparation ability**

Eating away from home and fast food consumption, have been associated with nutrient poor and energy dense dietary intakes. Greater cooking ability and confidence has been shown to positively influence the diet quality of adults (Wolfson & Bleich, 2015) and university students (Laska, Hearst, Lust, Lytle, & Story, 2015). Research has primarily focused on adult populations, with both cross-sectional and longitudinal study designs showing the more confident someone is in preparing their own meals, the more likely they are to have high diet quality, such as greater intakes of fruits and vegetables and less frequent fast food consumption (Laska, Larson, Neumark-Sztainer, & Story, 2012; Monsivais, Aggarwal, & Drewnowski, 2014; Utter, Larson, et al., 2018). There is evidence that university students, and other young adult populations, lack meal preparation skills and are therefore more likely to consume pre-prepared meals and eat out than are older adults (Laska et al., 2015; Smith et al., 2010; Sprake et al., 2018; Thorpe et al., 2014).

The time constraints and social pressures that university students experience may lead to less importance being placed on food preparation, particularly if they've recently left home (Wilson et al., 2017). Time constraints has been identified as a major barrier to healthy dietary behaviours in university students. Larson et al. (2006) found 36% of students reported lack of time was a barrier to food preparation. Furthermore, the sample of students from a study by Sogari, Velez-Argumedo, Gomez, and Mora (2018) reported involvement in food preparation was an enabler for healthy behaviours. The current evidence suggests a combination of lacking food preparation skills and time constraints may explain why university students prioritise convenience when it comes to meal times (Marquis, 2005).

#### **2.4.6 Food and nutrition knowledge**

Evidence from the few studies that have investigated the relationship between nutrition knowledge and diet quality points towards a positive association between nutrition knowledge and diet quality in university students (Cooke & Papadaki, 2014; Dissen, Policastro, Quick, & Byrd-Bredbenner, 2011; Hartman et al., 2013). Hartman et al. (2013) investigated the determinants of fruit and vegetable consumption in New Zealand university students, and assessed the differences between students in health and non-health related disciplines. She found students of health-related studies were more aware of the beneficial effects of fruit and vegetable intake, and suggested study disciplines may reflect differences in food and nutrition knowledge. In Germany, Keller et al. (2008) found medical students were less likely to exhibit

risky behaviours such as low fruit and vegetable intake, binge drinking, smoking and low physical activity levels than those studying non-health related disciplines. On the other hand, a study in Sweden found orthorexia nervosa, described as an exaggerated fixation on healthy food (Malmborg, Bremander, Olsson, & Bergman, 2017), was higher in exercise science students than in business students. Together, these findings indicate nutrition knowledge may not always positively affect diet quality.

#### **2.4.7 Food insecurity**

The World Health Organization states food security exists in a population when “all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern” (World Health Organization, 2002). Food insecurity exists when “people do not have adequate physical, social or economic access to food as defined above” (World Health Organization, 2002). Food insecurity is associated with unhealthy dietary patterns, and increased risk of obesity and chronic diseases (Beck et al., 2018).

The prevalence of food insecurity in university student populations has been investigated in recent years (Bruening, van Woerden, Todd, & Laska, 2018; Micevski, Thornton, & Brockington, 2014). Studies in Canada and the US report about 30% or more of students experience some degree of food insecurity (Cuy Castellanos & Holcomb, 2018; Morris, Smith, Davis, & Null, 2016; Olauson, Engler-Stringer, Vatanparast, & Hanoski, 2018; Reynolds, Johnson, Jamieson, & Mawhinney, 2018). In fact, Martinez, Webb, Frongillo, and Ritchie (2018) investigated ten different universities across the US and found a concerning 42% of students had experienced food insecurity during their first year of university.

These findings are not restricted to North American populations, studies show similar levels of food insecurity in Australian university student populations (Gallegos, Ramsey, & Ong, 2014; Hughes, Serebryanikova, Donaldson, & Leveritt, 2011; Micevski et al., 2014). In New Zealand Utter et al (2018) found food insecurity concerns of adolescents had increased based on nationally representative surveys done in 2007 and 2012. This finding, although not based on a university student sample, indicate there are food security concerns in New Zealand.

Students who are food insecure are more likely to perceive their health status as poor or sub-par compared to those who are food secure (Gallegos et al., 2014; Hughes et al., 2011).

University students who were food insecure were more likely to be overweight or obese, go to their classes hungry, defer their studies due to financial difficulties and report worse grades than those with no food security concerns (Farahbakhsh et al. (2017); Gallegos et al. (2014); Utter, Izumi, Denny, Fleming, and Clark (2018). The prevalence of food insecurity among university students and New Zealand adolescents indicates food insecurity may also be an influence on diet quality in New Zealand university students.

## **2.5 Current state of knowledge in New Zealand and purpose of proposed study**

Relative to the international literature, research on the diet quality of university students in New Zealand populations is sparse. To date, there have been only two published studies on the dietary intakes of university student populations. Horwath (1991) investigated dietary intake of undergraduate students studying at Otago University using 3-day diet diaries and compared them to the 1983 Recommendations for Selected Nutrient Intakes of New Zealanders (NZRs) and the 1989 US Recommended Daily Allowances (US RDAs), which were current at the time. She found the mean intakes for most nutrients were above both the US RDAs and NZRs in men, and almost all mean intakes for women fell below the NZRs due to low energy intakes; including iron, vitamin B6, zinc, vitamin B12, magnesium, folate and copper (Horwath, 1991). These findings are important to reflect on for future studies considering how much has changed in university and student culture, as well as nutritional recommendations since 1991. A more recent study in 2013 used focus group sessions to assess psychosocial determinants of fruit and vegetable intake of Massey University students in Wellington. The majority of the sample investigated met fruit and vegetable intake recommendations, and reported having a negative attitude, lack of knowledge and self-efficacy as determinants of fruit and vegetable consumption. The study also concluded that university students have a different lifestyle compared to many other young adults and that more research is required (Hartman et al., 2013).

Neither study investigated diet quality as a whole (i.e. pattern or index) in their sample of university students. While, Hartman et al (2013) looked into the psychosocial determinants of fruit and vegetable consumption, no other potential determinants were investigated. Given the shift in dietary patterns in New Zealand over the past few decades (Smith et al., 2015), and that no recent studies have investigated diet quality and its potential determinants in university students in New Zealand, the aim of this study is to investigate the relationship between diet quality and its associated factors in a group of university students living in New Zealand.

### 3 Manuscript

*Prepared according to author guidelines for submission to the journal titled Nutrients*

*Article*

## Diet quality of New Zealand University Students and Influencing Factors: A Pilot Study

Panossian Armand <sup>1</sup>, Weber Janet <sup>2</sup>, Jasmine S. Thomson <sup>2</sup>

<sup>1</sup> Massey Institute of Food Science and Technology, School of Sport, Exercise and Nutrition, College of Health, Massey University, Private Bag 102904, North Shore City, Auckland 0745, New Zealand; a.panossian@massey.ac.nz

<sup>2</sup> Massey Institute of Food Science and Technology, School of Food and Advanced Technology, College of Science, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand; j.weber@massey.ac.nz; j.a.thomson@massey.ac.nz

Received: date; Accepted: date; Published: date

**Abstract:** Literature indicates university students engage in unhealthy behaviours; research on this topic in New Zealand is sparse. This study investigated diet quality and associated factors in a group of university students enrolled at Massey University's Albany Campus, New Zealand. A self-administered online questionnaire was used to collect data on dietary habits as well as factors that were associated with diet quality in previous research. A Diet Index (DI) was developed to assess diet quality, with scores reflecting dietary recommendations outlined in the Eating and Activity Guidelines for New Zealand Adults (EAGNZ). Forty participants were recruited. The mean diet quality score was 54.2 points out of 80, with a standard deviation of 10.6 points. The majority of participants met dietary guidelines for fruit (70%), vegetables (57.5%) and 'Extra' food intake (77.5%), while less than half of participants met dietary guidelines for grains (2.5%), wholegrains (30%), alcohol (40%), saturated fat (32.5%), added sugar (25%) and added salt (10%). Of the potential influencing factors investigated, binge drinking ( $P < 0.01$ ) and food preparation ( $P < 0.01$ ) were negatively associated with diet quality while confidence in basic cooking techniques ( $P = 0.05$ ) and frequency of supplement use ( $P < 0.01$ ) were significantly associated with diet quality. The current study identified potential influencing factors as well as components of the diet in this population that were below dietary recommendations, and findings suggest university students exhibit unique health-related behaviours. This is particularly concerning given the evidence that university students lack the confidence and/or ability to prepare meals that contribute to optimal dietary habits, and are likely to engage in binge drinking; which was negatively associated with diet quality in the current study. Further research with improved methodology, specifically in regards to the diet quality index used, is needed to build on the findings in this study.

**Keywords:** Diet quality; university students; New Zealand

---

### 3.1 Introduction

Non-communicable diseases (NCDs) account for 63% of global mortality. Poor nutrition in Western cultures have been shown to be an important risk factor in the development of NCDs (1). Furthermore, approximately 47% of deaths in New Zealand can be attributed to nutrition-related risk factors such as harmful alcohol use, high salt intake, high sugar intake, low fruit and vegetable intake, and high body mass index (2, 3). In order to improve diet quality, it is important to understand current dietary intake and the determinants in a particular population.

Young adulthood presents a period in the life course when individuals have greater responsibility for food choices compared to childhood and adolescence (4). There is evidence to show a decrease in diet quality during this transition period as dietary intake patterns respond to life course events such as moving away from home and beginning higher education (5, 6). Literature on the dietary and health behaviours of young adults at university show this population engages in unhealthy behaviours such as high consumption of fast foods (7, 8), high consumption of snack foods (7, 9, 10), excessive alcohol consumption (11, 12), and inadequate fruit and vegetable intake (7, 13). An understanding of the factors associated with these undesirable dietary behaviours in the university student population is needed, particularly in New Zealand where the literature in this area is sparse.

Since people do not eat foods or nutrients in isolation; interest has grown around dietary patterns as opposed to single nutrients (14, 15). This has led to the development of dietary scores, or diet indices (DIs), that are based on national dietary guidelines which reflect existing knowledge of good dietary practices in a country. DIs are essentially a scoring system, interpreting data gathered on dietary behaviours such as fruit and vegetable intake and added salt intake for example, into a score that demonstrates adherence of an individual or population to national dietary guidelines. A DI developed in Australia to reflect national nutrition guidelines and recommendations, the Dietary Guideline Index for Australian adults (DGI), found resulting diet quality scores were related to dietary behaviours such as cooking ability and frequency of convenience meal consumption (16). Diet quality in university students has been associated with other factors, such as living situation and sourcing of food (13, 17). It is important to investigate these factors, as well as the risky and health promoting behaviours observed in this population (18-20), as they may be useful in understanding current underlying health attitudes.

To date, only two published studies have investigated the diet of university students in New Zealand. In 1991 researchers analysed nutrient intakes from 3-day diet records of undergraduate students in

Dunedin and compared them to the 1983 Recommendations for Selected Nutrient Intakes of New Zealanders as well as the US RDAs (21), which were current at the time. These findings may no longer represent the diet of current university students given the change in environment and culture since 1991. A more recent study by Hartman, Wadsworth (22) focused on factors associated with fruit and vegetable intake among university students in Wellington, and concluded that more research is required given the unique lifestyle found in their sample of university students compared to other young adults. While Hartman looked into the psychosocial determinants of fruit and vegetable consumption and found the majority of her sample met fruit and vegetable intake recommendations, no other potential determinants were investigated.

Therefore, the current study aims to assess the diet quality of a group of university students living in New Zealand and investigate potential influencing factors using a DI that reflects the current New Zealand nutrition recommendations and diet guidelines.

## **3.2 Materials and Methods**

This was a pilot study that examined the relationship between diet quality and its influencing factors in a group of university students. The study's protocol was approved by the Massey University Human Ethics Committee, Southern A (MUHEC) (Application number: 18/10). The study was advertised through posters around Massey University's Albany campus. Participants were recruited for the study from July to August of 2018. Participants were required to be 18 years of age or over and be enrolled in either part time or full time study at Massey University's Albany campus at the time of recruitment. Potential participants expressed their interest through mail to a dedicated email address. All subjects gave their informed consent before they participated in the study.

Participants were required to complete a self-administered online questionnaire distributed on SurveyMonkey (SurveyMonkey Inc. San Mateo, USA) (Appendix A). The questionnaire was developed using a combination of questions used in the New Zealand 2008/09 National Nutrition Survey (NNS) (23), the alcohol use disorders identification test developed by the WHO (24), and previous research that assessed cooking frequency, attitudes and confidence in university students (25).

The Questionnaire was divided into sections, including demographics, food security, food accessibility and preparation, use of dietary supplements, risky and health behaviours and dietary habits. Questions on food intake included definitions and examples of serving sizes. The majority of questions were closed but also included a small number of open-ended questions to obtain information such as the name or brand of a supplement.

Diet quality was measured using a diet index developed to reflect the EAGNZ, and based on the Dietary Guideline Index (DGI) used by Thorpe, Kestin (16) in their investigation of diet quality and food-related



behaviours in university students. The following components were included in the DI; fruit, vegetables, grain foods, wholegrain foods, alcohol, saturated fat, added sugars, added salt, and discretionary or 'extra' foods not essential in providing nutrients to meet requirements. In contrast to Thorpe & Kestin's DGI; diet variety, lean meat, dairy, fluid and unsaturated oil intake were excluded from the DI used in the current study. Each component was scored out of 10 with a maximum possible total score of 80 points (Appendix B). As suggested by Waijers, Feskens (26), a proportionate score for each component was given if participants consumed intermediate amounts of what was recommended. A more thorough break down of the diet quality scoring tool can be found in Appendix B, along with a comparison with Thorpe and colleagues DGI (27).

The data attained through the online questionnaire was downloaded and analysed using the statistical software package IBM SPSS Statistics Version 25. Diet quality scores were calculated manually for each participant and were normally distributed, as determined using the Shapiro-Wilk test. Where appropriate, variable categories were combined to provide adequate numbers for further analysis. One-way ANOVA tests were used to examine mean differences in DGI scores between categorical variables; a p value of  $\leq 0.05$  was considered statistically significant. When variables with more than two categories were significantly associated with diet quality scores, LSD Post-Hoc tests were used to determine where the significance lay (28).

### 3.3 Results

Forty students completed the questionnaire. Key characteristics of the study population alongside diet quality score analyses are presented in Table 1. Most participants were women, 18-24 years old, born in New Zealand and of New Zealand European ethnicity. No association was found between diet quality scores and key characteristics of the sample ( $P > 0.05$ ).

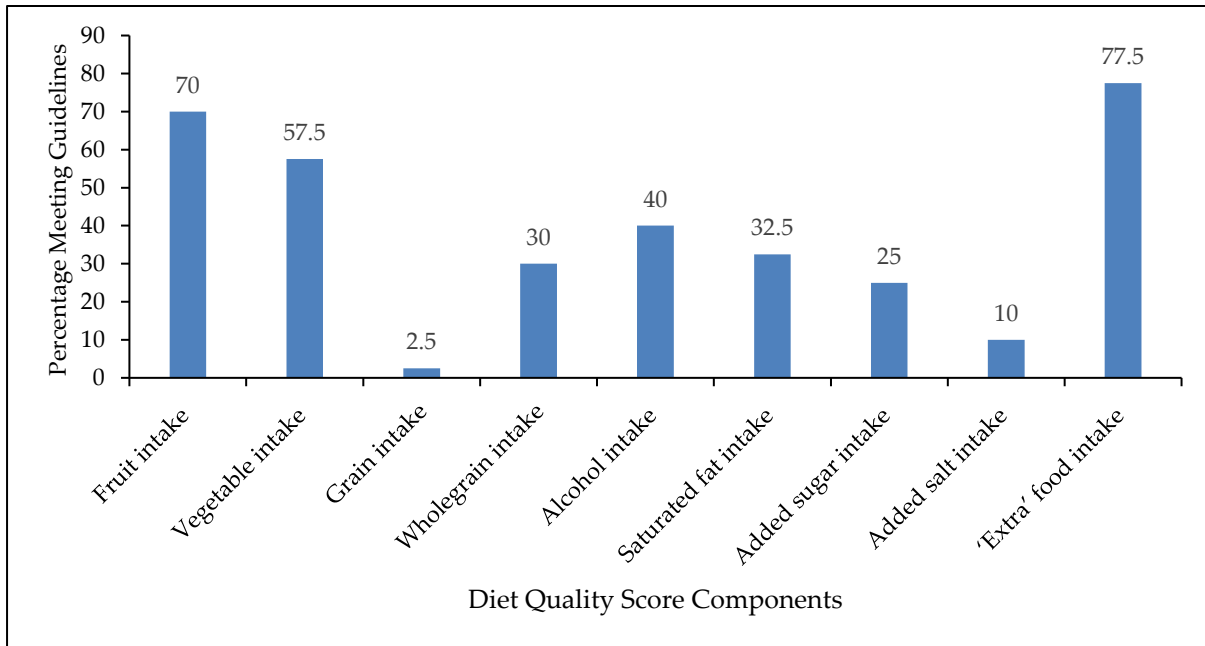
**Table 3.1** Key characteristics of a sample of university students

	<i>n</i> *	%
Age		
18-24	32	80
$\geq 25$	8	20
Sex		
Male	14	35
Female	26	65
Ethnicity		
NZE/Pakeha	28	71.8
Other	11	28.2
Country of birth		
New Zealand	26	66.7

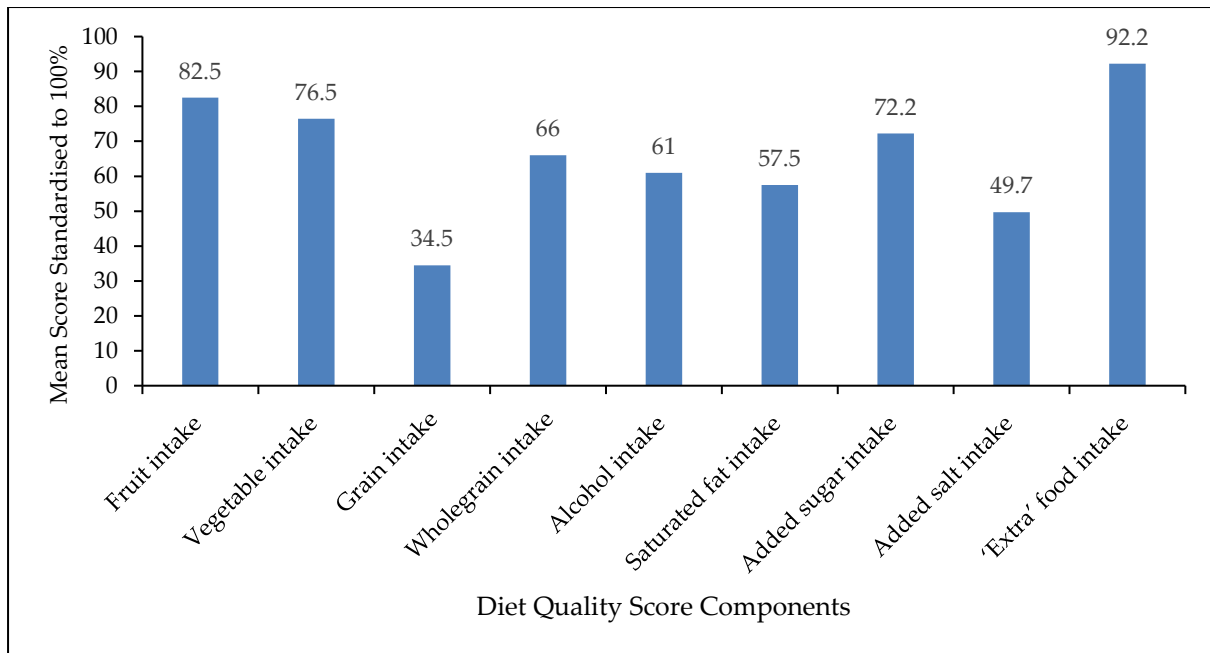
\*total  $n$  varies between measures due to missing responses

†One-way ANOVA

The overall mean diet quality score was 54.2 points out of 80, with a standard deviation of 10.6 points and a range of 22 to 75. Less than half of the sample investigated met the dietary guidelines for grains, wholegrains, alcohol, saturated fat, added sugar and added salt (See figure 3.1). Participants scored relatively higher for fruit, vegetable, added sugar and 'extra' food intake (>70%), and lower for grains, alcohol, saturated fat and added salt intake (<70%) (See figure 3.2).



**Figure 3.1** Proportion of sample attaining maximum score for each diet quality score component, representative of EAGNZ and Recommended dietary intakes for Australia and New Zealand



**Figure 3.2** Mean diet quality score for each component for all participants standardised to 100%

The variables listed in Table 3 have been associated with diet quality in university students and young adults internationally in previous literature. The mean diet quality scores across these variables, as assessed in the questionnaire, are shown in Table 3.2. No significant differences in mean diet quality scores were found across different living situations, gender or income.

**Table 3.2** Potential influencing factors compared to mean diet quality scores

	<i>n</i> *	%	Diet Quality Scores		<i>P</i> value†
			Mean	SD	
Demographics					
Sex					
Male	14	35	50.7	12.13	0.13
Female	26	65	56.1	9.36	
Gross Income in the past 12 months					
\$15,000 or less	15	41.7	53.7	13.47	0.65
Over \$15,000	21	58.3	55.4	8.89	
Who do you live with					
Flatmates	14	35	55.7	9.54	0.50
Family/other	26	65	53.4	11.19	
Accommodation					
On campus dorm/off campus apartment	6	15	53.4	4.92	0.85
At home	34	85	54.3	11.33	

Full or part time study					
Part time	8	20.5	54.7	6.80	0.90
Full time	31	79.5	54.2	11.58	
Health promoting and risky behaviours					
Frequency of supplement intake					
Infrequent/episodic	18	45	48.8	10.17	<0.01
Frequent/regular	22	55	58.6	8.84	
Participating in moderate exercise for at least 30 minutes					
Never/Less than once per week	4	10.4	57.6	9.55	0.04
1-2 times per week	9	23.8	53.7	5.54	
3-4 times per week	15	39.5	49.7 <sup>‡</sup>	12.89	
5-6 times per week	10	26.3	61.6 <sup>‡</sup>	7.1	
Smoked a total of more than 100 cigarettes across lifetime					
Yes	6	15	49.2	8.57	0.22
No	34	85	55.1	10.77	
Number of times 6 or more alcoholic drinks are consumed on one occasion					
Never	10	25.6	59.5	7.18	<0.01
Less than Monthly	17	43.6	57.5	8.60	
Monthly	12	30.8	46.7	10.22	
Weekly or more often	0	0	0	0	
Food preparation and purchasing behaviours					
Cook your own meals					
Yes	6	15	42.9	13.24	<0.01
No	34	85	56.2	8.86	
Bringing food from home to eat on campus					
1-2 times per week or less	17	42.5	50.9	11.92	0.09
At least 3-4 times per week	23	57.5	56.6	8.97	
Buying food from student cafeteria, café or food cart					
1-2 times per week or less	35	87.5	54.0	10.84	0.81
At least 3-4 times per week	5	12.5	55.3	9.56	
Buying food/beverages from the vending machine on campus					
1-2 times per week or less	37	92.5	54.1	10.83	0.83
At least 3-4 times per week	3	7.5	55.5	10.40	
Confidence in using basic cooking techniques					
Not confident	14	35	49.7	11.47	0.05
Confident	26	65	56.6	9.43	
Health attitudes and knowledge					
Study Discipline					
Non-health	20	50	51.6	11.48	0.12

Health	20	50	56.8	9.13	
Importance of eating healthy					
Neutral	3	7.5	50.7	1.76	<0.01
Important	18	45	48.1 <sup>‡</sup>	9.61	
Very important	19	47.5	60.5 <sup>‡</sup>	8.54	
Perception of diet quality					
Poor/fair	18	45	48.0 <sup>‡</sup>	9.70	<0.01
Good/excellent	22	55	59.2 <sup>‡</sup>	8.50	
Food security					
Afford to eat properly					
Always	29	72.5	54.8	11.7	0.55
Sometimes	11	27.5	52.5	7.00	
Food runs out in my/our household due to lack of money					
Often	2	5.1	43.0	7.07	0.16
Sometimes	8	20.5	58.0	6.53	
Never	29	74.4	53.2	10.67	

\*total *n* varies between measures due to missing responses

†One-way ANOVA

<sup>‡</sup> Categories within variables which are significantly different ( $P = \leq 0.05$ )

A number of health related behaviours were associated with diet quality scores. The majority of participants (41.7%) reported they drink 3-4 alcoholic drinks on a typical day drinking, while 22% reported they drink 5-6 drinks. Additionally, 30.8% of participants reported they binge drink (drink 6 or more alcoholic drinks on one occasion) monthly. Binge drinking was significantly associated with diet quality scores ( $P = <0.01$ ). The majority of participants (80%) had taken a nutritional supplement in the past 12 months, the most common types being a single vitamin/mineral (30%) or an amino acid/protein supplement (23%). No significant association was found between diet quality and whether participants had a nutritional supplement in the past 12 months ( $P = 0.47$ ), or with the types of supplements taken ( $P = 0.71$ ). However, those that reported consuming a supplement frequently or regularly (55%) had a higher mean diet quality score than those that reported infrequently or episodic supplement use (45%) ( $P = <0.01$ ). Participating in moderate exercise for at least 30 minutes 5-6 times per week was associated with higher mean diet quality scores compared to 1-2 times per week ( $P = 0.04$ ), however, those that participated 3-4 times per week had the lower mean diet quality scores than those who participated 1-2 times per week. Overall, these results indicate that both risky and health promoting behaviours were significantly associated with mean diet quality scores in the current study. Diet quality scores were examined in relation to students cooking confidence and source of food. Less than half of the sample (35.9%) brought food from home to eat on campus 5 times a week. On the other hand, only 5% of participants bought food from the student cafeteria or food cart at least 3-4 times per week. Neither frequency of eating at student café or food cart ( $P = 0.12$ ), nor frequency of bringing food

from home were associated with diet quality ( $P = 0.19$ ). Over half (65%) of the participants reported feeling either confident or extremely confident using basic cooking techniques. This factor was significantly associated with higher diet quality scores ( $P = 0.05$ ). However, only 15% of participants reported cooking their own meals, which was associated with lower diet quality scores ( $P = 0.01$ ).

Almost half of the students (47.5%) felt it was very important “to eat healthy”, and 45% reported it was ‘important’. Furthermore, over half of students thought their diet quality was either ‘good’ or ‘excellent’ (55%). Both importance of eating healthy and perception of diet quality were significantly associated with diet quality scores ( $P = <0.01$ ). Post hoc tests revealed those who perceived their diet quality as excellent had a significantly higher diet quality score than those who perceived their diet as being poor ( $P = 0.01$ ). Of the study population, 27.5% felt they could afford to eat properly only sometimes, while 20.5% reported to sometimes run out of food in their household due to lack of money. These variables, as well as the others in the Food Security questionnaire, did not have a significant association with diet quality (refer to Appendix C).

### **3.4 Discussion**

The reported diet of this group showed some positive characteristics, with most meeting fruit and over half meeting vegetable intake recommendations, which is relatively high compared to previous studies on university students internationally (7, 18) and young adults in New Zealand (29), yet it is considerably less than a previous study on university students of different study disciplines in New Zealand (22). A large proportion of participants did not follow recommendations for saturated fat intake and added salt. However, over two thirds of participants reported limiting their ‘extra’ food intake to 1-2 times per week or less, in contrast to overseas research that showed high consumption of snack foods and convenience foods in university students (11, 16). Overall, the dietary practices of participants in the current study for fruit, vegetable, and ‘extra’ food intakes were closer to the recommended guidelines than were their grains, alcohol, saturated fat and added salt intakes.

The mean diet quality score in this sample of university students was 54.2 points out of a possible 80, or 67.7% of the maximum score attainable. The mean DGI score in the study by Thorpe, Kestin (16) was 62.3% of the maximum score attainable, while the mean DGI score in a different study investigating the diet quality of an Australian sample of adults was 69.4% (30). Although these scores are comparable and may reflect similar levels of adherence to diet recommendations for both university student and adult populations, caution must be applied due to the exclusion of a few variables in the current diet quality scoring tool compared to the DGI used by Thorpe and colleagues (16).

The current study did not find gender to be significantly associated with diet quality scores. This is inconsistent with some research (31-33), including a nationally representative health survey carried out

last year in New Zealand which indicated women are more likely to meet fruit and vegetable intake recommendations (29). It is possible that while men and women may differ in relation to specific components that make up the overall diet; such as binge drinking or fruit and vegetable intake (11), the overall diet quality scores may be similar; as observed in the study by Thorpe, Kestin (16). Another explanation may be that the sample investigated were mostly women, and men were possibly not well represented in this pilot study.

Whether food was brought from home or purchased on campus was not associated with diet quality scores in the current study. These findings differ to previous research that found bringing your own food from home to university had a positive relationship with diet quality (34, 35), and that purchasing foods and beverages had an inverse relationship with diet quality (17). The lack of a significant relationship found between diet quality and food purchasing behaviour may be due to the relatively low proportion of students reporting to purchase foods from on-campus outlets. Another hypothesis may be the time spent on campus. The impact of foods and beverages offered on campus would have minimal impact for students who spent less time on campus, for example part-time students spend less time on campus than their full-time counterparts. However, the majority of students in the current study were full-time students, supporting the previous hypothesis.

Participants who reported some level of confidence in using basic cooking techniques had a greater mean diet quality score compared to those who were not confident, this finding is synonymous with previous studies on university students (9). However, only 15% were responsible for cooking their own meals, which interestingly was negatively associated with diet quality scores, contrary to previous research (16). This negative association may be explained by the fact that most participants in the current study lived in an off-campus house with their families. A possible explanation may be that the 'person' doing the cooking for participants living with their families is from a different demographic and is more likely to follow dietary recommendations, such as parents/grandparents/caregivers, therefore this group may have better eating habits. Previous research on the association between diet quality and living situation has yielded conflicting results across different countries (15, 36, 37) which highlight the importance of local context, and how it's influence on eating patterns varies across similar research, even in Western societies. A large portion of university students in overseas research, particularly in the US, live in on-campus housing or dorms where more desirable dietary habits have been observed compared to students living off-campus (13, 37). This is not the case in New Zealand, or at least in the current population, where the majority lived at home (85%). The impact that living on campus has on diet quality in NZ could be better understood if the study population included more first year students attending a university known to have a large percentage of students living and eating in on-campus dorms.

Binge drinking poses both immediate and long-term health risks, and is of particular concern within the scope of the present study, as students who reported binge drinking also had significantly lower diet quality scores. El Ansari, Stock (11) found 70.5% of students across seven universities in the UK reported binge drinking in the past month; this and other research suggests the risky behaviour is intrinsic to university culture both internationally and in NZ (11, 18, 38, 39). The prevalence of binge drinking, defined by 6 or more alcoholic drinks consumed in one occasion, in the current sample was relatively low; with only 30.8% of participants reporting to binge drink monthly. This may be explained by the current sample being mostly women; who are less likely to engage in binge drinking than men (11). Alternatively, the low prevalence may indicate bias in the sample as a result of participation being voluntary. The current study builds on the limited research that has investigated the inverse association with diet quality internationally (12).

Supplement use in the past 12 months was reported by 80% of participants, higher than the 47.6% reported by the general population in New Zealand in 2008 (23); suggesting university students and younger adults may be more likely to consume them. Furthermore, those who reported taking supplements frequently/regularly had a higher mean diet quality score compared to those who took supplements infrequently/episodically. Supplement use has been positively associated with diet quality in previous research on university students as well as young adult populations (40-42); authors of which have suggested rather than supplements being consumed to meet nutrient deficiencies, supplement users already consume diets that meet dietary recommendations through diet alone. Expanding on this hypothesis, by taking supplements students are exhibiting some interest in their own health, this interest may be a result of an underlying positive attitude towards health that also influences their dietary habits to be more favourable.

Over a quarter of participants took part in moderate exercise for 30 minutes 5-6 times during the week, which is low compared to 58.4% of young adults aged 18-24 years who reported the same level of exercise in the NZ annual health survey (29). Despite the low prevalence, this behaviour was associated with diet quality. This is consistent with previous research in the UK that found high levels of physical activity to be linked with more optimal dietary patterns (9), and is an interesting finding in light of some recent research that suggested increased physical activity may also increase the likelihood of following recommended dietary habits (43).

Previous research on the relationship of nutrition knowledge and diet quality in adults have reported positive, but weak associations (44). Nutrition knowledge may be influenced by study discipline, and few studies have assessed whether study discipline is associated with diet quality. Keller, Maddock (38) examined multiple health behaviours of first year university students and found medical students exhibited more positive dietary patterns than other students. Hartman, Wadsworth (22) found similar



results in NZ, with students of health related studies being more aware of the beneficial effects of fruit and vegetable intake; suggesting that what students study at university may reflect differences in food and nutrition knowledge. Contrary to these findings, there was no difference in diet quality scores between students studying health or non-health disciplines in the current study. Although, because participation was voluntary, participants may have been more likely to exhibit favourable dietary behaviours regardless of study discipline.

Food beliefs and attitudes were associated with diet quality in the current study as both perception of their own diet quality and the importance placed on eating healthy were positively associated with diet quality scores. This may indicate the sample of students were relatively aware of their own dietary habits and what is recommended. A negative attitude towards the importance of diet has been identified as a deterrent of fruit and vegetable intake in a previous study in New Zealand (NZ) (22). Hartman and colleagues found taste and convenience to take highest priority in their sample's decision making, suggesting long term health consequences or benefits may not be motivating enough for young people to consume enough fruits and vegetables. However, previous research in the UK found both nutrition knowledge and attitudes towards healthy eating were predictors of diet quality, and that nutrition label use was a mediating factor (45, 46). Given these findings, future studies may benefit from assessing nutrition label use in addition to other factors assessed in the current study.

The key strength of this pilot study is that it is the first of its kind in New Zealand to assess dietary patterns using a DI method and examine relationship to a range of factors in a sample of university students. After addressing shortfalls in the current pilot study, the method could be used to monitor changes in diet quality and be compared with future studies to shed light on what is considered to be a 'good' or 'bad' diet quality score. Although the aim of using the diet quality scoring tool was to reflect EAGNZ, the tool has not been validated. Additionally, it lacked insight into diet variety, lean meat, dairy, and fluid; aspects of the EAGNZ that were excluded due to shortcomings in the questionnaire. It is not clear whether the absence of these components would change any of the results, however future studies will benefit from the addition of questions on these topics. By not using the DGI from Thorpe, Milte (27), or other established DI, we could not make direct comparisons with previous research. The other important limitation was the small sample size, which likely meant the study was underpowered to discern some associations between hypothesized factors and diet quality, as observed in previous research.

### 3.5 Conclusions

This pilot study set out to assess the diet quality of a sample of university students living in New Zealand, and investigate potential influencing factors. The study identified components of the diet in this population that were commonly not meeting dietary recommendations; including intake of grains, wholegrains, alcohol, saturated fat and added salt. Of the factors investigated, attitudes, health promoting and risky behaviours, food preparation and purchasing behaviours, as well as confidence in basic cooking techniques were significantly associated with diet quality. This was a pilot study. Given the small sample size and the fact that the DI scoring tool used has not been validated, these results need to be interpreted with caution.

**Acknowledgments:** This work and costs to publish open access were funded by the School of Food and Advanced Technology, Massey University. We would like to thank the men and women who participated in the study.

**Author Contributions:** A. P. was responsible for recruitment of participants, data collection, data analysis, results and discussion formulation, and preparation of manuscript. J. T., and J. W. provided supervision throughout study; including the design and conduct of study, ethics application, and writing of thesis.

**Conflicts of Interest:** The authors declare no conflict of interest.

### 3.6 References

1. Marrero S, Bloom D, Adashi E. Noncommunicable Diseases A Global Health Crisis in a New World Order. *Jama-Journal of the American Medical Association*. 2012;307(19):2037-8.
2. Ministry of Health, University of Auckland. *Nutrition and the burden of disease: New Zealand 1997-2011* 2003 [Available from: [http://www.moh.govt.nz/notebook/nbbooks.nsf/0/A8D85BC5BAD17610CC256D970072A0AA/\\$file/nutritionandtheburdenofdisease.pdf](http://www.moh.govt.nz/notebook/nbbooks.nsf/0/A8D85BC5BAD17610CC256D970072A0AA/$file/nutritionandtheburdenofdisease.pdf).
3. Stefanogiannis N, Lawes CMM, Turley M, Tobias M, Vander Hoorn S, Mhurchu CN, et al. Nutrition and the burden of disease in New Zealand: 1997-2011. *Public Health Nutrition*. 2005;8(4):395-401.
4. Thiele S, Mensink GBM, Beitz R. Determinants of diet quality. *Public Health Nutrition*. 2004;7(1):29-37.
5. Craigie A, Mathers J, Rugg-Gunn A, Adamson A. Change in nutrient intake between adolescence and adulthood: a 21-year longitudinal study. *Nutrition Bulletin*. 2004;29(3):204-12.
6. Forshee RA, Storey ML. Demographics, not beverage consumption, is associated with diet quality. *International Journal of Food Sciences and Nutrition* 2006;57(7-8):494-511.
7. El Ansari W, Stock C, Mikolajczyk R. Relationships between food consumption and living arrangements among university students in four European countries-a cross-sectional study. *Nutrition Journal*. 2012;11(1):90-7.
8. Tanton J, Dodd LJ, Woodfield L, Mabhala M. Eating behaviours of British university students: A cluster analysis on a neglected issue. *Advances in Preventive Medicine*. 2015;2015:1-8.
9. Sprake EF, Russell JM, Cecil JE, Cooper RJ, Grabowski P, Pourshahidi LK, et al. Dietary patterns of university students in the UK: a cross-sectional study. *Nutrition Journal*.

2018;17:90-107.

10. Wansink B, Cao Y, Saini P, Shimizu M, Just DR. College cafeteria snack food purchases become less healthy with each passing week of the semester. *Public Health Nutrition*. 2013;16(7):1291-5.
11. El Ansari W, Stock C, John J, Deeny P, Phillips C, Snelgrove S, et al. Health promoting behaviours and lifestyle characteristics of students at seven universities in the UK. *Central European Journal of Public Health*. 2011;19(4):197-204.
12. Nelson MC, Lust K, Story M, Ehlinger E. Alcohol use, eating patterns, and weight behaviors in a university population. *American Journal of Health Behavior*. 2009;33(3):227-37.
13. Small M, Bailey-Davis L, Morgan N, Maggs J. Changes in eating and physical activity behaviors across seven semesters of college: Living on or off campus matters. *Health Education & Behavior*. 2013;40(4):435-41.
14. Darnton-Hill I, Nishida C, James WPT. A life course approach to diet, nutrition and the prevention of chronic diseases. *Public Health Nutrition*. 2004;7(1A):101-21.
15. Papadaki A, Hondros G, Scott JA, Kapsokefalou M. Eating habits of University students living at, or away from home in Greece. *Appetite*. 2007;49(1):169-76.
16. Thorpe MG, Kestin M, Riddell LJ, Keast RSJ, McNaughton SA. Diet quality in young adults and its association with food-related behaviours. *Public Health Nutrition*. 2014;17(8):1767-75.
17. Roy R, Rangan A, Hebden L, Yu Louie JC, Tang LM, Kay J, et al. Applied nutritional investigation: Dietary contribution of foods and beverages sold within a university campus and its effect on diet quality of young adults. *Nutrition*. 2017;34:118-23.
18. Dodd LJ, Al-Nakeeb Y, Nevill A, Forshaw MJ. Lifestyle risk factors of students: a cluster analytical approach. *Preventive medicine*. 2010;51(1):73-7.
19. Lieberman HR, Marriott BP, Williams C, Judelson DA, Glickman EL, Geiselman PJ, et al. Patterns of dietary supplement use among college students. *Clinical Nutrition*. 2015;34(5):976-85.
20. Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Changes in weight and health behaviors from freshman through senior year of college. *Journal of nutrition education and behavior*. 2008;40(1):39-42.
21. Horwath CC. Dietary-intake and nutritional-status among university undergraduates. *Nutrition Research*. 1991;11(5):395-404.
22. Hartman H, Wadsworth DP, Penny S, van Assema P, Page R. Psychosocial determinants of fruit and vegetable consumption among students in a New Zealand university. Results of focus group interviews. *Appetite*. 2013;65:35-42.
23. University of Otago, Ministry of Health. *A focus on nutrition: Key findings of the 2008/09 New Zealand adult nutrition survey 2011* [Available from: <https://www.health.govt.nz/system/files/documents/publications/a-focus-on-nutrition-v2.pdf>].
24. World Health Organization. *The alcohol use disorders identification test 2001* [Available from: [https://apps.who.int/iris/bitstream/handle/10665/67205/WHO\\_MSD\\_MSB\\_01.6a.pdf;jsessionid=F47EA2E01CB19E394FC1E152DE3E4628?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/67205/WHO_MSD_MSB_01.6a.pdf;jsessionid=F47EA2E01CB19E394FC1E152DE3E4628?sequence=1)].
25. Minkow S. *Cooking attitudes, behaviors, and self-efficacy in relation to fruit and vegetable intake among young adults*: California State University, Long Beach; 2016.
26. Wijers P, Feskens EJM, Ocke MC. A critical review of predefined diet quality scores. *British Journal of Nutrition*. 2007;97(2):219-31.
27. Thorpe M, Milte C, Crawford D, McNaughton S. A revised Australian Dietary Guideline Index and its association with key sociodemographic factors, health behaviors and body mass index in peri-retirement aged adults. *Nutrients*. 2016;8(3):160.

28. Field A. *Discovering statistics using IBM SPSS statistics*: sage; 2013.
29. Ministry of Health. *Annual update of key results 2017/18: New Zealand health survey 2019* [Available from: [https://minhealthnz.shinyapps.io/nz-health-survey-2017-18-annual-data-explorer/\\_w\\_0811ceee/\\_w\\_3bed3b6c/\\_w\\_4f838324/\\_w\\_42a576be/\\_w\\_361ab2c9/#!/explore-indicators](https://minhealthnz.shinyapps.io/nz-health-survey-2017-18-annual-data-explorer/_w_0811ceee/_w_3bed3b6c/_w_4f838324/_w_42a576be/_w_361ab2c9/#!/explore-indicators)].
30. Smith, McNaughton SA, Gall SL, Otahal P, Dwyer T, Venn AJ. Research: Associations between partnering and parenting transitions and dietary habits in young adults. *Journal of the Academy of Nutrition and Dietetics*. 2017;117:1210-21.
31. Beck KL, Jones B, Ullah I, McNaughton SA, Haslett SJ, Stonehouse W. Associations between dietary patterns, socio-demographic factors and anthropometric measurements in adult New Zealanders: an analysis of data from the 2008/09 New Zealand Adult Nutrition Survey. *European Journal of Nutrition*. 2018;57(4):1421-33.
32. Tam R, Yassa B, Parker H, O'Connor H, Allman-Farinelli M. University students' on-campus food purchasing behaviors, preferences, and opinions on food availability. *Nutrition*. 2017;37:7-13.
33. Li K, Concepcion RY, Lee H, Cardinal BJ, Ebbeck V, Woekel E, et al. An examination of sex differences in relation to the eating habits and nutrient intakes of university students. *Journal of Nutrition Education and Behavior*. 2012;44(3):246-50.
34. Monsivais P, Aggarwal A, Drewnowski A. Time spent on home food preparation and indicators of healthy eating. *American Journal of Preventive Medicine*. 2014;47(6):796-802.
35. Laska MN, Hearst MO, Lust K, Lytle LA, Story M. How we eat what we eat: identifying meal routines and practices most strongly associated with healthy and unhealthy dietary factors among young adults. *Public Health Nutrition*. 2015;18(12):2135-45.
36. Harker D, Sharma B, Harker M, Reinhard K. Leaving home: Food choice behavior of young German adults. *Journal of Business Research*. 2010;63(2):111-5.
37. Laska M, Larson N, Neumark-Sztainer D, Story M. Dietary patterns and home food availability during emerging adulthood: do they differ by living situation? *Public Health Nutrition*. 2010;13(2):222-8.
38. Keller S, Maddock JE, Hannoever W, Thyrian JR, Basler HD. Multiple health risk behaviors in German first year university students. *Preventive Medicine*. 2008;46(3):189-95.
39. Kypri K, Paschall M, Langley J, Baxter J, Cashell-Smith M, Bourdeau B. Drinking and alcohol-related harm among New Zealand university students: Findings from a national web-based survey. *Alcoholism: Clinical and experimental research*. 2009;33(2):307-14.
40. Wiltgren AR, Booth AO, Kaur G, Cicerale S, Lacy KE, Thorpe MG, et al. Micronutrient supplement use and diet quality in university students. *Nutrients*. 2015;7(2):1094-107.
41. Blumberg JB, Frei B, Fulgoni VL, Weaver CM, Zeisel SH. Contribution of Dietary Supplements to Nutritional Adequacy in Various Adult Age Groups. *Nutrients*. 2017;9(12):1325-35.
42. Anders S, Schroeter C. The impact of nutritional supplement intake on diet behavior and obesity outcomes. *PLOS One*. 2017;12(10):1-17.
43. Joo J, Williamson S, Vazquez A, Fernandez J, Bray M. The influence of 15-week exercise training on dietary patterns among young adults. *International Journal of Obesity*. 2019:1.
44. Spronk I, Kullen C, Burdon C, O'Connor H. Relationship between nutrition knowledge and dietary intake. *British Journal of Nutrition*. 2014;111(10):1713-26.
45. Cooke R, Papadaki A. Nutrition label use mediates the positive relationship between nutrition knowledge and attitudes towards healthy eating with dietary quality among university students in the UK. *Appetite*. 2014;83:297-303.
46. Graham DJ, Laska MN. Nutrition Label Use Partially Mediates the Relationship

between Attitude toward Healthy Eating and Overall Dietary Quality among College Students. *Journal of the Academy of Nutrition and Dietetics*. 2012;112(3):414-8.

© 2019 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).



## 4 Conclusions and Recommendations

### 4.1 Overview and conclusions

The aim of this study was to assess the extent to which a sample of university students in New Zealand comply with dietary guidelines and examine the association of diet quality with factors including demographics, food preparation and purchasing behaviours, health attitudes and knowledge, food security and health promoting and risky behaviours. This was achieved through the use of a food frequency questionnaire and diet quality index tailored to reflect the EAGNZ; an *a priori* method of dietary pattern analysis not previously applied to an adult population in New Zealand. The mean diet quality score in the sample was 54.2 (68%) points out of a possible 80, just over two thirds of the maximum possible score. Participants scored higher for fruit, vegetable, added sugar and 'extra' food intake compared to grains, alcohol, saturated fat and added salt intake.

Diet quality, as measured by diet quality scores, was positively associated with the importance placed on eating healthy as well as perception of diet quality. Frequency of supplement use and moderate exercise were also positively associated with diet quality, while frequency of binge drinking was negatively associated with diet quality. Of the food preparation and purchasing behaviours investigated, confidence in basic cooking techniques and cooking your own meals was associated with diet quality, although surprisingly the latter was inversely associated.

Students who felt their diet quality was 'good' or 'excellent' had significantly higher diet quality scores than those who felt their diet quality was 'fair' or 'poor', this may indicate the sample of students were relatively aware of their own dietary habits and what is recommended. Furthermore, the majority of the sample felt it was at least 'important' to eat healthy; these findings suggest that the sample recruited may have been biased by appealing to the more health orientated than the general university student population. The prevalence of binge drinking in the sample was relatively low compared to previous research on university student populations (Dodd et al., 2010; El Ansari et al., 2011), with 30.8% of participants engaging in the behaviour monthly. Despite this, binge drinking was associated inversely associated with diet quality. The immediate and long-term risks of binge drinking are well known (Room et al., 2005), and the current study provides further evidence the risky behaviour is associated with a lower quality diet (Nelson et al., 2009). A low proportion of students were responsible

for cooking their own meals (15%), which was negatively associated with diet quality; this may be indicative that university students lack the skills or knowledge to prepare healthy meals. This is of particular concern when combined with the negative association found between frequency of binge drinking, a risky behaviour shown to be prevalent in other university student populations, and diet quality. Further research in larger, representative samples of university students may establish these concerns and provide a target for future health promotion strategies.

## **4.2 Strengths of current research**

The key strength of this pilot study is being the first of its kind in New Zealand to assess dietary patterns of university students through the use of a diet quality index and investigate associations with a range of factors. The current study was able to capture dietary data from a unique population of young adults and measure the level of adherence to the EAGNZ. The level of adherence to each guideline or component, can be used as a reference for future studies in New Zealand. The diet index can also be refined and validated for further use. Few studies have assessed dietary habits between different study disciplines in university student populations, a strength of the current study was to recruit participants that were not from solely health-related disciplines. Another strength was to assess other behaviours related to health, for example binge drinking and physical activity. Recent literature suggests these behaviours cluster with other health related behaviours such as healthy eating (Lazzeri et al., 2016); gaining an understanding of behavioural clustering may provide clarity in underlying attitudes and motivation to engage in health promoting behaviours, and positively impact the planning of future health promotion strategies. Overall, this study provides an insight into the level of adherence to dietary recommendations in New Zealand university students which may spark interest for future research, and the limitations identified may provide valuable information to guide future research on this type of dietary pattern analysis in the future, specifically in the university student population in New Zealand.

## **4.3 Limitations of research**

Research on diet quality of university students and its potential determinants has received interest internationally (Deshmukh-Taskar et al., 2010; Erin et al., 2019; Kourouniotis et al., 2016; Thorpe et al., 2014; Wiltgren et al., 2015), however similar research in New Zealand is sparse (Hartman et al., 2013; Horwath, 1991). Being the first in New Zealand is a strength of the current study; however, the reader should bear in mind that there were several limitations

in the methodology. The dietary index scoring tool developed was novel in assessing whether dietary patterns adhered to the EAGNZ and has not yet been validated. The questionnaire used did not allow the diet quality index to reflect the guidelines for nuts, legumes & lean meat, dairy, and fluid intake, thus not a complete view of adherence to NZ guidelines. Another absence from the index used was diet variety, which was intentionally excluded to prevent the methodology being too intensive for participants; as a 3-day diet diary would have been required in addition to the FFQ to calculate this variable (Thorpe et al., 2014). In addition, the use of a unique diet index led to difficulty comparing the diet quality scores in the current study with scores from similar research internationally. Although the questionnaire was made up of pre validated questions used in the NNS 08/09 and previous literature, it was not pre tested before data collection.

The small sample size was also a limiting factor in the current study, which meant the study was underpowered to discern some associations. Additionally, the population that was investigated in this pilot study does not reflect the wider New Zealand university student population as recruitment was limited to one university on Auckland's North Shore. Among the differences between universities is living situation; living in on-campus housing or dorms in New Zealand, particularly Massey University's Auckland campus, is far less prevalent than other universities in New Zealand and internationally. This made it difficult to assess the dietary impact of living on campus and compare it with previous studies. The method of recruitment of volunteers, is a possible explanation for what appears to be a potential health bias in the population. Therefore, participants may have been more likely to take interest in nutrition or health regardless of study discipline.

#### **4.4 Recommendations for future research**

The methods used in this pilot study need to be revised and the study carried out to wider, more representative sample of NZ university students in order to better understand the dietary habits of this unique population.

The DI scoring tool developed was novel and can be improved on by including nuts & legumes to accommodate for vegetarians, as well as lean meat, dairy, and fluid to more accurately represent the EAGNZ. Alternatively, given the similar cultures and nutrition guidelines between New Zealand and Australia, future studies may benefit from using exactly the same questionnaire and dietary index used by Thorpe et al. (2014) and make only slight adjustments to the components. In New Zealand, the use of a dietary index to investigate overall dietary



patterns has been utilised recently with adolescent populations (Wong et al., 2015). A New Zealand Diet Quality Index for Adolescents (NZDQI-A) was developed based on New Zealand dietary recommendations for healthy adolescents; adapting this index for adult populations is another option in further research in NZ. Future studies may benefit from evaluating the culture and food environment of the university campus before choosing it to carry out a similar investigation, and recruiting a larger proportion of students living on campus dorms/apartments is recommended. Lastly, in order for the nutritional impact of food purchasing behaviours on or around campus to be more clearly understood, it may be beneficial to investigate time spent on campus.

Further research is needed to build on the findings in this study to advance the understanding of university student dietary habits and influencing factors; the subsequent findings may better help public health strategies in this unique population.

## References

- Anders, S., & Schroeter, C. (2017). The impact of nutritional supplement intake on diet behavior and obesity outcomes. *PLOS One*, *12*(10), 1-17. doi:10.1371/journal.pone.0185258
- Arroyo, M., Rocandio, A., Ansotegui, L., Pascual, E., Salces, I., & Rebato, E. (2006). Diet quality, overweight and obesity in university students. *Nutrición Hospitalaria*, *21*(6), 673-679.
- Beck, K. L., Jones, B., Ullah, I., McNaughton, S. A., Haslett, S. J., & Stonehouse, W. (2018). Associations between dietary patterns, socio-demographic factors and anthropometric measurements in adult New Zealanders: an analysis of data from the 2008/09 New Zealand Adult Nutrition Survey. *European Journal of Nutrition*, *57*(4), 1421-1433. doi:10.1007/s00394-017-1421-3
- Beerman, K. A., Jennings, G., & Crawford, S. (1990). The effect of student residence on food choice. *Journal of American College Health*, *38*, 215-220. doi:10.1080/07448481.1990.9936190
- Blumberg, J. B., Frei, B., Fulgoni, V. L., Weaver, C. M., & Zeisel, S. H. (2017). Contribution of Dietary Supplements to Nutritional Adequacy in Various Adult Age Groups. *Nutrients*, *9*(12), 1325-1335. doi:10.3390/nu9121325
- Boggs, D. A., Rosenberg, L., Rodríguez-Bernal, C. L., & Palmer, J. R. (2013). Long-Term Diet Quality Is Associated with Lower Obesity Risk in Young African American Women with Normal BMI at Baseline. *Journal of Nutrition*, *143*(10), 1636-1641. doi:10.3945/jn.113.179002
- Breslow, R. A., Guenther, P. M., & Smothers, B. A. (2006). Alcohol drinking patterns and diet quality: the 1999-2000 National Health and Nutrition Examination Survey. *American Journal of Epidemiology*, *163*(4), 359-366. doi:10.1093/aje/kwj050
- Brown, L. B., Dresen, R. K., & Eggett, D. L. (2005). College students can benefit by participating in a prepaid meal plan. *Journal of the American Dietetic Association*, *105*(3), 445-448. doi:10.1016/j.jada.2004.12.030
- Bruening, M., van Woerden, I., Todd, M., & Laska, M. N. (2018). Hungry to learn: The prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of university freshmen. *International Journal of Behavioral Nutrition and Physical Activity*, *15*(1). doi:10.1186/s12966-018-0647-7
- Brunt, A. R., & Rhee, Y. S. (2008). Obesity and lifestyle in US college students related to living arrangements. *Appetite*, *51*(3), 615-621. doi:10.1016/j.appet.2008.04.019
- Burgoine, T., Sarkar, C., Webster, C. J., & Monsivais, P. (2018). Examining the interaction of fast-food outlet exposure and income on diet and obesity: evidence from 51,361 UK Biobank participants. *International Journal of Behavioural Nutrition and Physical Activity*, *15*, 71-83. doi:10.1186/s12966-018-0699-8
- Chen, M., Li, Y., Sun, Q., Pan, A., Manson, J., Rexrode, K. M., . . . Hu, F. B. (2016). Dairy fat and risk of cardiovascular disease in 3 cohorts of US adults. *The American Journal of Clinical Nutrition*, *104*(5), 1209-1217.
- Chu, Y. H., Frongillo, E. A., Jones, S. J., & Kaye, G. L. (2009). Improving patrons' meal selections through the use of point-of-selection nutrition labels. *American Journal of Public Health*, *99*(11), 2001-2005.
- Commonwealth Department of Health and Ageing Australia, New Zealand Ministry of Health, & National Health and Medical Research Council. (2006). *Nutrient reference values for Australia and New Zealand including recommended dietary intakes*. Retrieved from <https://www.nhmrc.gov.au/sites/default/files/images/nutrient-reference->

[dietary-intakes.pdf](#)

- Cooke, R., & Papadaki, A. (2014). Nutrition label use mediates the positive relationship between nutrition knowledge and attitudes towards healthy eating with dietary quality among university students in the UK. *Appetite*, 83, 297-303. doi:10.1016/j.appet.2014.08.039
- Craigie, A., Mathers, J., Rugg - Gunn, A., & Adamson, A. (2004). Change in nutrient intake between adolescence and adulthood: a 21 - year longitudinal study. *Nutrition Bulletin*, 29(3), 204-212.
- Cuy Castellanos, D., & Holcomb, J. (2018). Food insecurity, financial priority, and nutrition literacy of university students at a mid-size private university. *Journal of American College Health*. doi:10.1080/07448481.2018.1515762
- Darnton-Hill, I., Nishida, C., & James, W. P. T. (2004). A life course approach to diet, nutrition and the prevention of chronic diseases. *Public Health Nutrition*, 7(1A), 101-121. doi:10.1079/phn2003584
- Deforche, B., Van Dyck, D., Deliens, T., & De Bourdeaudhuij, I. (2015). Changes in weight, physical activity, sedentary behaviour and dietary intake during the transition to higher education: a prospective study. *International Journal of Behavioral Nutrition and Physical Activity*, 12(1), 16.
- Deliens, T., Clarys, P., De Bourdeaudhuij, I., & Deforche, B. (2014). Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC public health*, 14(1), 53.
- Deshmukh-Taskar, P. R., Radcliffe, J. D., Liu, Y., & Nicklas, T. A. (2010). Do breakfast skipping and breakfast type affect energy intake, nutrient intake, nutrient adequacy, and diet quality in young adults? NHANES 1999–2002. *Journal of the American College of Nutrition*, 29(4), 407-418. doi:10.1080/07315724.2010.10719858
- DiNicolantonio, J. J., Lucan, S. C., & O’Keefe, J. H. (2016). The evidence for saturated fat and for sugar related to coronary heart disease. *Progress in Cardiovascular Diseases*, 58(5), 464-472.
- Dissen, A. R., Policastro, P., Quick, V., & Byrd-Bredbenner, C. (2011). Interrelationships among nutrition knowledge, attitudes, behaviors and body satisfaction. *Health Education*, 111(4), 283-295.
- Dodd, L. J., Al-Nakeeb, Y., Nevill, A., & Forshaw, M. J. (2010). Lifestyle risk factors of students: a cluster analytical approach. *Preventive medicine*, 51(1), 73-77.
- Driskell, J. A., Schake, M. C., & Detter, H. A. (2008). Using nutrition labeling as a potential tool for changing eating habits of university dining hall patrons. *Journal of the American Dietetic Association*, 108(12), 2071-2076.
- Edwards, J. S. A., & Meiselman, H. L. (2003). Changes in dietary habits during the first year at university. *Nutrition Bulletin*, 28(1), 21-34. doi:10.1046/j.1467-3010.2003.00306.x
- El Ansari, W., Stock, C., John, J., Deeny, P., Phillips, C., Snelgrove, S., . . . Mabhala, A. (2011). Health promoting behaviours and lifestyle characteristics of students at seven universities in the UK. *Central European Journal of Public Health*, 19(4), 197-204. doi:10.21101/cejph.a3684
- El Ansari, W., Stock, C., & Mikolajczyk, R. (2012). Relationships between food consumption and living arrangements among university students in four European countries-a cross-sectional study. *Nutrition Journal*, 11(1), 90-97.
- Erin, L. F., Lindsay, M., Sharon, I. K., David, H., Leia, M. M., & Dana Lee, O. (2019). Socioeconomic disadvantage across the life course is associated with diet quality in young adulthood. *Nutrients*, 11(2), 242-259. doi:10.3390/nu11020242
- Farahbakhsh, J., Hanbazaza, M., Ball, G. D. C., Farmer, A. P., Maximova, K., & Willows, N. D. (2017). Food insecure student clients of a university-based food bank have compromised health, dietary intake and academic quality. *Nutrition & Dietetics*, 74(1),

- 67-73. doi:10.1111/1747-0080.12307
- Forshee, R. A., & Storey, M. L. (2006). Demographics, not beverage consumption, is associated with diet quality. *International Journal of Food Sciences and Nutrition* 57(7-8), 494-511. doi:10.1080/09637480600991240
- Freedman, M. R., & Brochado, C. (2010). Reducing portion size reduces food intake and plate waste. *Obesity*, 18(9), 1864-1866.
- Freedman, M. R., & Connors, R. (2011). Point-of-purchase nutrition information influences food-purchasing behaviors of college students: a pilot study. *Journal of the American Dietetic Association*, 111(5), 42-46.
- Gallegos, D., Ramsey, R., & Ong, K. W. (2014). Food insecurity: Is it an issue among tertiary students? *Higher Education*, 67(5), 497-510. doi:10.1007/s10734-013-9656-2
- Gil, Á., Martínez de Victoria, E., & Olza, J. (2015). Indicators for the evaluation of diet quality. *Nutricion Hospitalaria*, 31(3), 128-144.
- Glanz, K., Sallis, J. F., Saelens, B. E., & Frank, L. D. (2005). Healthy nutrition environments: concepts and measures. *American journal of health promotion*, 19(5), 330-333.
- Greaney, M. L., Less, F. D., White, A. A., Dayton, S. F., Riebe, D., Blissmer, B., . . . Greene, G. W. (2009). College students' barriers and enablers for healthful weight management: a qualitative study. *Journal of Nutrition Education and Behavior*, 41(4), 281-286.
- Grech, A., Hebden, L., Roy, R., & Allman - Farinelli, M. (2017). Are products sold in university vending machines nutritionally poor? A food environment audit. *Nutrition & Dietetics*, 74(2), 185-190. doi:10.1111/1747-0080.12332
- Greene, G. W., Schembre, S. M., White, A. A., Hoerr, S. L., Lohse, B., Shoff, S., . . . Blissmer, B. (2011). Identifying clusters of college students at elevated health risk based on eating and exercise behaviors and psychosocial determinants of body weight. *Journal of the American Dietetic Association*, 111(3), 394-400. doi:10.1016/j.jada.2010.11.011
- Gropper, S. S., Simmons, K. P., Connell, L. J., & Ulrich, P. V. (2012). Weight and body composition changes during the first three years of college. *Journal of Obesity*, 2012. doi:10.1155/2012/634048
- Guerrero, M., & Perez-Rodriguez, F. (2017). Diet Quality Indices for Nutrition Assessment: Types and Applications. In *Functional Food: Intech*.
- Guo, S., Huang, C., Maynard, L., Demerath, E., Towne, B., Chumlea, W. C., & Siervogel, R. (2000). Body mass index during childhood, adolescence and young adulthood in relation to adult overweight and adiposity: the Fels Longitudinal Study. *International Journal of Obesity*, 24(12), 1628-1635.
- Harker, D., Sharma, B., Harker, M., & Reinhard, K. (2010). Leaving home: Food choice behavior of young German adults. *Journal of Business Research*, 63(2), 111-115.
- Hartman, H., Wadsworth, D. P., Penny, S., van Assema, P., & Page, R. (2013). Psychosocial determinants of fruit and vegetable consumption among students in a New Zealand university. Results of focus group interviews. *Appetite*, 65, 35-42. doi:10.1016/j.appet.2013.02.005
- Horwath, C. C. (1991). Dietary-intake and nutritional-status among university undergraduates. *Nutrition Research*, 11(5), 395-404. doi:10.1016/s0271-5317(05)80001-6
- Hu, F. B. (2002). Dietary pattern analysis: a new direction in nutritional epidemiology. *Current Opinion in Lipidology*, 13(1), 3-9. doi:10.1097/00041433-200202000-00002
- Hughes, R., Serebryanikova, I., Donaldson, K., & Leveritt, M. (2011). Student food insecurity: The skeleton in the university closet. *Nutrition & dietetics*, 68(1), 27-32.
- Jacques, P., & Tucker, K. (2001). Are dietary patterns useful for understanding the role of diet in chronic disease? In: Oxford University Press.
- Kasperek, D. G., Corwin, S. J., Valois, R. F., Sargent, R. G., & Morris, R. L. (2008). Selected health behaviors that influence college freshman weight change. *Journal of American College Health*, 56(4), 437-444.

- Keller, S., Maddock, J. E., Hannoever, W., Thyrian, J. R., & Basler, H. D. (2008). Multiple health risk behaviors in German first year university students. *Preventive Medicine, 46*(3), 189-195. doi:10.1016/j.ypmed.2007.09.008
- Kourouniotis, S., Keast, R. S. J., Riddell, L. J., Lacy, K., Thorpe, M. G., & Cicerale, S. (2016). The importance of taste on dietary choice, behaviour and intake in a group of young adults. *Appetite, 103*, 1-7. doi:10.1016/j.appet.2016.03.015
- Kuczmarski, M. F., Beydoun, M. A., Shupe, E. S., Pohl, R. T., Zonderman, A. B., & Evans, M. K. (2017). Use of dietary supplements improved diet quality but not cardiovascular and nutritional biomarkers in socioeconomically diverse african american and white adults. *Journal of Nutrition in Gerontology and Geriatrics, 36*(2-3), 92-110. doi:10.1080/21551197.2017.1299659
- Larson, N. I., Perry, C. L., Story, M., & Neumark-Sztainer, D. (2006). Food preparation by young adults is associated with better diet quality. *Journal of the American Dietetic Association, 106*(12), 2001-2007. doi:10.1016/j.jada.2006.09.008
- Laska, M., Larson, N., Neumark-Sztainer, D., & Story, M. (2010). Dietary patterns and home food availability during emerging adulthood: do they differ by living situation? *Public Health Nutrition, 13*(2), 222-228. doi:10.1017/s1368980009990760
- Laska, M. N., Hearst, M. O., Lust, K., Lytle, L. A., & Story, M. (2015). How we eat what we eat: identifying meal routines and practices most strongly associated with healthy and unhealthy dietary factors among young adults. *Public Health Nutrition, 18*(12), 2135-2145.
- Laska, M. N., Larson, N. I., Neumark-Sztainer, D., & Story, M. (2012). Does involvement in food preparation track from adolescence to young adulthood and is it associated with better dietary quality? Findings from a 10-year longitudinal study. *Public Health Nutrition, 15*(7), 1150-1158. doi:10.1017/s1368980011003004
- Laska, N. M., Pasch, K. E., Lust, K., Story, M., & Ehlinger, E. (2011). The differential prevalence of obesity and related behaviors in two- vs. Four-year colleges. *Obesity, 19*(2), 453-456. doi:10.1038/oby.2010.262
- Lazzeri, G., Panatto, D., Domnich, A., Arata, L., Pammolli, A., Simi, R., . . . Gasparini, R. (2016). Clustering of health-related behaviors among early and mid-adolescents in Tuscany: results from a representative cross-sectional study. *Journal of Public Health, 40*(1), e25-e33.
- Li, K., Concepcion, R. Y., Lee, H., Cardinal, B. J., Ebbeck, V., Woelke, E., & Readdy, R. T. (2012). An examination of sex differences in relation to the eating habits and nutrient intakes of university students. *Journal of Nutrition Education and Behavior, 44*(3), 246-250.
- Malmberg, J., Bremander, A., Olsson, M. C., & Bergman, S. (2017). Health status, physical activity, and orthorexia nervosa: A comparison between exercise science students and business students. *Appetite, 109*, 137-143. doi:10.1016/j.appet.2016.11.028
- Marquis, M. (2005). Exploring convenience orientation as a food motivation for college students living in residence halls. *International Journal of Consumer Studies, 29*(1), 55-63.
- Marrero, S., Bloom, D., & Adashi, E. (2012). Noncommunicable diseases a global health crisis in a new world order. *Journal of the American Medical Association, 307*(19), 2037-2038. doi:10.1001/jama.2012.3546
- Martinez, S. M., Webb, K., Frongillo, E. A., & Ritchie, L. D. (2018). Food insecurity in California's public university system: What are the risk factors? *Journal of Hunger and Environmental Nutrition, 13*(1), 1-18. doi:10.1080/19320248.2017.1374901
- McNaughton, S. A., Ball, K., Crawford, D., & Mishra, G. D. (2008). An index of diet and eating patterns is a valid measure of diet quality in an Australian population. *Journal of Nutrition, 138*(1), 86-93.

- Micevski, D. A., Thornton, L. E., & Brockington, S. (2014). Food insecurity among university students in Victoria: A pilot study. *Nutrition & Dietetics*, *71*(4), 258-264. doi:10.1111/1747-0080.12097
- Michels, K. B., & Schulze, M. B. (2005). Can dietary patterns help us detect diet-disease associations? *Nutrition Research Reviews*, *18*(2), 241-248. doi:10.1079/nrr2005107
- Ministry of Health. (2015). *Eating and activity guidelines for New Zealand adults*. Retrieved from [https://www.health.govt.nz/system/files/documents/publications/eating-activity-guidelines-for-new-zealand-adults-oct15\\_0.pdf](https://www.health.govt.nz/system/files/documents/publications/eating-activity-guidelines-for-new-zealand-adults-oct15_0.pdf)
- Ministry of Health. (2019). *Annual update of key results 2017/18: New Zealand health survey*. Retrieved from [https://minhealthnz.shinyapps.io/nz-health-survey-2017-18-annual-data-explorer/\\_w\\_0811ceee/\\_w\\_3bed3b6c/\\_w\\_4f838324/\\_w\\_42a576be/\\_w\\_361ab2c9/#!/explore-indicators](https://minhealthnz.shinyapps.io/nz-health-survey-2017-18-annual-data-explorer/_w_0811ceee/_w_3bed3b6c/_w_4f838324/_w_42a576be/_w_361ab2c9/#!/explore-indicators)
- Moeller, S., Reedy, J., Millen, A., Dixon, L. B., Newby, P., Tucker, K., . . . Guenther, P. (2007). Dietary patterns: challenges and opportunities in dietary patterns research: an Experimental Biology workshop, April 1, 2006. *Journal of the Academy of Nutrition and Dietetics*, *107*(7), 1233-1239.
- Monsivais, P., Aggarwal, A., & Drewnowski, A. (2014). Time spent on home food preparation and indicators of healthy eating. *American Journal of Preventive Medicine*, *47*(6), 796-802. doi:10.1016/j.amepre.2014.07.033
- Morrell, J. S., Lofgren, I. E., Burke, J. D., & Reilly, R. A. (2012). Metabolic syndrome, obesity, and related risk factors among college men and women. *Journal of American College Health*, *60*(1), 82-89.
- Morris, L. M., Smith, S., Davis, J., & Null, D. B. (2016). The prevalence of food security and insecurity among illinois university students. *Journal of Nutrition Education and Behavior*; *48*(6), 376-382.e371. doi:10.1016/j.jneb.2016.03.013
- Morrow, M. L., Heesch, K. C., Dinger, M. K., Hull, H. R., Kneehans, A. W., & Fields, D. A. (2006). Freshman 15: fact or fiction? *Obesity*, *14*(8), 1438-1443.
- Morse, K. L., & Driskell, J. A. (2009). Observed sex differences in fast-food consumption and nutrition self-assessments and beliefs of college students. *Nutrition Research*, *29*(3), 173-179.
- Murakami, K., & Livingstone, M. B. E. (2016). Energy density of meals and snacks in the British diet in relation to overall diet quality, BMI and waist circumference: Findings from the National Diet and Nutrition Survey. *British Journal of Nutrition*, *116*(8), 1479-1489. doi:10.1017/S0007114516003573
- National Health and Medical Research Council. (2013). *Eat for Health: Australian Dietary Guidelines*. Retrieved from file:///C:/Users/Armand/Downloads/australian-dietary-guidelines-2013%20(1).pdf
- Nelson, M. C., Lust, K., Story, M., & Ehlinger, E. (2009). Alcohol use, eating patterns, and weight behaviors in a university population. *American Journal of Health Behavior*, *33*(3), 227-237.
- Ng, K. W., Sangster, J., & Priestly, J. (2019). Assessing the availability, price, nutritional value and consumer views about foods and beverages from vending machines across university campuses in regional New South Wales, Australia. *Health Promotion Journal of Australia*, *30*(1), 76-82. doi:10.1002/hpja.34
- Nikolaou, C. K., Hankey, C. R., & Lean, M. E. J. (2014). Preventing weight gain with calorie - labeling. *Obesity*, *22*(11), 2277-2283.
- Ocké, M. C. (2013). Evaluation of methodologies for assessing the overall diet: dietary quality scores and dietary pattern analysis. *Proceedings of the Nutrition Society*, *72*(2), 191-199.
- Olauson, C., Engler-Stringer, R., Vatanparast, H., & Hanoski, R. (2018). Student food



- insecurity: Examining barriers to higher education at the University of Saskatchewan. *Journal of Hunger and Environmental Nutrition*, 13(1), 19-27. doi:10.1080/19320248.2017.1393365
- Olson, J. S., Hummer, R. A., & Harris, K. M. (2017). Gender and health behavior clustering among U.S. Young adults. *Biodemography and Social Biology*, 63(1), 3-20. doi:10.1080/19485565.2016.1262238
- Papadaki, A., Hondros, G., Scott, J. A., & Kapsokefalou, M. (2007). Eating habits of University students living at, or away from home in Greece. *Appetite*, 49(1), 169-176. doi:10.1016/j.appet.2007.01.008
- Papier, K., Ahmed, F., Lee, P., & Wiseman, J. (2015). Applied nutritional investigation: Stress and dietary behaviour among first-year university students in Australia: Sex differences. *Nutrition*, 31, 324-330. doi:10.1016/j.nut.2014.08.004
- Patterson, R. E., Haines, P. S., & Popkin, B. M. (1994). Diet quality index: capturing a multidimensional behavior. *Journal of the American Dietetic Association*, 94(1), 57-64.
- Peterson, S., Duncan, D. P., Null, D. B., Roth, S. L., & Gill, L. (2010). Positive changes in perceptions and selections of healthful foods by college students after a short-term point-of-selection intervention at a dining hall. *Journal of American College Health*, 58(5), 425-431.
- Racette, S. B., Deusinger, S. S., Strube, M. J., Highstein, G. R., & Deusinger, R. H. (2008). Changes in weight and health behaviors from freshman through senior year of college. *Journal of Nutrition Education and Behavior*, 40(1), 39-42.
- Radimer, K., Bindewald, B., Hughes, J., Ervin, B., Swanson, C., & Picciano, M. F. (2004). Dietary supplement use by US adults: Data from the National Health and Nutrition Examination Survey, 1999-2000. *American Journal of Epidemiology*, 160(4), 339-349. doi:10.1093/aje/kwh207
- Reynolds, E., Johnson, C., Jamieson, J. A., & Mawhinney, H. (2018). Prevalence and correlates of food insecurity among students attending a small, rural Canadian university. *Canadian Journal of Dietetic Practice and Research*, 79(3), 125-128. doi:10.3148/cjdpr-2018-004
- Room, R., Babor, T., & Rehm, J. (2005). Alcohol and public health. *The Lancet*, 365(9458), 519-530.
- Roy, R., Rangan, A., Hebden, L., Yu Louie, J. C., Tang, L. M., Kay, J., & Allman-Farinelli, M. (2017). Applied nutritional investigation: Dietary contribution of foods and beverages sold within a university campus and its effect on diet quality of young adults. *Nutrition*, 34, 118-123. doi:10.1016/j.nut.2016.09.013
- Roy, R., Soo, D., Conroy, D., Wall, C., & Swinburn, B. (2019). Exploring university food environment and on-campus food purchasing behaviors, preferences, and opinions. *Journal of Nutrition Education and Behavior*, 51(7), 865-875. doi:<https://doi.org/10.1016/j.jneb.2019.03.003>
- Schulze, M., & Hoffmann, K. (2006). Methodological approaches to study dietary patterns in relation to risk of coronary heart disease and stroke. *British Journal of Nutrition*, 95(5), 860-869.
- Serlachius, A., Hamer, M., & Wardle, J. (2007). Stress and weight change in university students in the United Kingdom. *Physiology & Behavior*, 92(4), 548-553.
- Serra-Majem, L., Bach, A., & Roman, B. (2006). Recognition of the Mediterranean diet: going a step further. *Public Health Nutrition*, 9(1a), 101-102.
- Shi, Y., Colagiuri, S., Wang, Q., Norman, C., & Allman-Farinelli, M. (2018). It is time to make policy for healthier food environments in Australian universities. *Nutrients*, 10(12), 1909-1921. doi:10.3390/nu10121909
- Shim, J.-S., Oh, K., & Kim, H. C. (2014). Dietary assessment methods in epidemiologic

- studies. *Epidemiology and health*, 36.
- Small, M., Bailey-Davis, L., Morgan, N., & Maggs, J. (2013). Changes in eating and physical activity behaviors across seven semesters of college: Living on or off campus matters. *Health Education & Behavior*, 40(4), 435-441. doi:10.1177/1090198112467801
- Smith, McNaughton, S. A., Gall, S. L., Otahal, P., Dwyer, T., & Venn, A. J. (2017). Research: Associations between partnering and parenting transitions and dietary habits in young adults. *Journal of the Academy of Nutrition and Dietetics*, 117, 1210-1221. doi:10.1016/j.jand.2016.12.008
- Smith, C., Gray, A. R., Mainvil, L. A., Fleming, E. A., & Parnell, W. R. (2015). Secular changes in intakes of foods among New Zealand adults from 1997 to 2008/09. *Public Health Nutrition*, 18(18), 3249-3259. doi:10.1017/S1368980015000890
- Smith, K., McNaughton, S. A., Gall, S., Blizzard, L., Dwyer, T., & Venn, A. J. (2009). Takeaway food consumption and its associations with diet quality and abdominal obesity: a cross-sectional study of young adults. *International Journal of Behavioral Nutrition and Physical Activity*, 6(1), 29.
- Smith, K. J., McNaughton, S. A., Gall, S. L., Blizzard, L., Dwyer, T., & Venn, A. J. (2010). Research: Involvement of young Australian adults in meal preparation: Cross-sectional associations with sociodemographic factors and diet quality. *Journal of the American Dietetic Association*, 110, 1363-1367. doi:10.1016/j.jada.2010.06.011
- Sofi, F., Cesari, F., Abbate, R., Gensini, G., & Casini, A. (2008). Adherence to Mediterranean diet and health status: meta-analysis. *The BMJ*, 337, a1344.
- Sogari, G., Velez-Argumedo, C., Gomez, M. I., & Mora, C. (2018). College students and eating habits: A study using an ecological model for healthy behavior. *Nutrients*, 10(1823-1839). doi:10.3390/nu10121823
- Sprake, E. F., Russell, J. M., Cecil, J. E., Cooper, R. J., Grabowski, P., Pourshahidi, L. K., & Barker, M. E. (2018). Dietary patterns of university students in the UK: a cross-sectional study. *Nutrition Journal*, 17, 90-107. doi:10.1186/s12937-018-0398-y
- Stefanogiannis, N., Lawes, C. M. M., Turley, M., Tobias, M., Vander Hoorn, S., Mhurchu, C. N., & Rodgers, A. (2005). Nutrition and the burden of disease in New Zealand: 1997-2011. *Public Health Nutrition*, 8(4), 395-401. doi:10.1079/phn2004694
- Strawson, C., Bell, R., Downs, S., Farmer, A., Olstad, D., & Willows, N. (2013). Dietary patterns of female university students with nutrition education. *Canadian Journal of Dietetic Practice and Research*, 74(3), 138-142. doi:10.3148/74.3.2013.138
- Stroebele, N., Ogden, L. G., & Hill, J. O. (2009). Do calorie-controlled portion sizes of snacks reduce energy intake? *Appetite*, 52(3), 793-796.
- Tam, R., Yassa, B., Parker, H., O'Connor, H., & Allman-Farinelli, M. (2017). University students' on-campus food purchasing behaviors, preferences, and opinions on food availability. *Nutrition*, 37, 7-13. doi:10.1016/j.nut.2016.07.007
- Tanton, J., Dodd, L. J., Woodfield, L., & Mabhala, M. (2015). Eating behaviours of British university students: A cluster analysis on a neglected issue. *Advances in Preventive Medicine*, 2015, 1-8. doi:<http://dx.doi.org/10.1155/2015/639239>
- The Children's Health Development Foundation, & Deakin University. (1998). *Australian guide to healthy eating*. Retrieved from <http://nht.org.au/wp-content/uploads/2014/03/AustralianGuidetoHealthyEating.pdf>
- Thiele, S., Mensink, G. B. M., & Beitz, R. (2004). Determinants of diet quality. *Public Health Nutrition*, 7(1), 29-37. doi:10.1079/phn2003516
- Thorpe, M., Milte, C., Crawford, D., & McNaughton, S. (2016). A revised Australian Dietary Guideline Index and its association with key sociodemographic factors, health behaviors and body mass index in peri-retirement aged adults. *Nutrients*, 8(3), 160.
- Thorpe, M. G., Kestin, M., Riddell, L. J., Keast, R. S. J., & McNaughton, S. A. (2014). Diet quality in young adults and its association with food-related behaviours. *Public Health*



- Nutrition*, 17(8), 1767-1775. doi:10.1017/s1368980013001924
- Towl, D., & Alcohol Advisory Council of New Zealand. (2004). *Alcohol use and tertiary students in Aotearoa – New Zealand* (Occasional Publication No. 21). Retrieved from [https://www.hpa.org.nz/sites/default/files/imported/field\\_research\\_publication\\_file/TertiaryStudent.pdf](https://www.hpa.org.nz/sites/default/files/imported/field_research_publication_file/TertiaryStudent.pdf)
- Tucker, K. L. (2010). Dietary patterns, approaches, and multicultural perspective. *Applied Physiology Nutrition and Metabolism*, 35(2), 211-218. doi:10.1139/h10-010
- Utter, J., Izumi, B. T., Denny, S., Fleming, T., & Clark, T. (2018). Rising food security concerns among New Zealand adolescents and association with health and wellbeing. *Kotuitui-New Zealand Journal of Social Sciences Online*, 13(1), 29-38. doi:10.1080/1177083x.2017.1398175
- Utter, J., Larson, N., Laska, M. N., Winkler, M., & Neumark-Sztainer, D. (2018). Self-perceived cooking skills in emerging adulthood predict better dietary behaviors and intake 10 years later: A longitudinal study. *Journal of Nutrition Education & Behavior*, 50(5), 494-500. doi:10.1016/j.jneb.2018.01.021
- van den Bogerd, N., Maas, J., Seidell, J. C., & Dijkstra, S. C. (2018). Fruit and vegetable intakes, associated characteristics and perceptions of current and future availability in Dutch university students. *Public Health Nutrition*, 1-9. doi:10.1017/S136898001800174X
- Vyncke, K., Fernandez, E. C., Fajo-Pascual, M., Cuenca-Garcia, M., De Keyzer, W., Gonzalez-Gross, M., . . . Consortium, H. (2013). Validation of the Diet Quality Index for Adolescents by comparison with biomarkers, nutrient and food intakes: the HELENA study. *British Journal of Nutrition*, 109(11), 2067-2078. doi:10.1017/s000711451200414x
- Waijers, P., Feskens, E., & Ocké, M. (2007). A critical review of predefined diet quality scores. *British Journal of Nutrition*, 97(2), 219-231.
- Wansink, B., Cao, Y., Saini, P., Shimizu, M., & Just, D. R. (2013). College cafeteria snack food purchases become less healthy with each passing week of the semester. *Public Health Nutrition*, 16(7), 1291-1295. doi:10.1017/S136898001200328X
- Wardle, J., & Steptoe, A. (1991). The European health and behaviour survey: rationale, methods and initial results from the United Kingdom. *Social Science & Medicine*, 33(8), 925-936.
- Wilson, C. K., Matthews, J. I., Seabrook, J. A., & Dworatzek, P. D. N. (2017). Self-reported food skills of university students. *Appetite*, 108, 270-276. doi:10.1016/j.appet.2016.10.011
- Wiltgren, A. R., Booth, A. O., Kaur, G., Cicerale, S., Lacy, K. E., Thorpe, M. G., . . . Riddell, L. J. (2015). Micronutrient supplement use and diet quality in university students. *Nutrients*, 7(2), 1094-1107.
- Wirfält, E., Drake, I., & Wallström, P. (2013). What do review papers conclude about food and dietary patterns? *Food & Nutrition Research*, 57(1), 20523.
- Wolfson, J. A., & Bleich, S. N. (2015). Is cooking at home associated with better diet quality or weight-loss intention? *Public Health Nutrition*, 18(8), 1397-1406. doi:10.1017/S1368980014001943
- Wong, J. E., Parnell, W. R., Howe, A. S., Lubransky, A. C., Black, K. E., & Skidmore, P. M. L. (2015). Diet quality is associated with measures of body fat in adolescents from Otago, New Zealand. *Public Health Nutrition*, 18(8), 1453-1460. doi:10.1017/s1368980014001645
- World Health Organization. (2002). *The world health report 2002: Reducing risks, promoting healthy life*: World Health Organization.

## 5 Appendices

### Appendix A: EATS Questionnaire

A1. What is your date of birth?

Sorry but this date of birth (     /     /     ) means the participant is under 16 years old and so cannot be part of the study!

### Section B Healthy Eating

We'd like to start with your thoughts on healthy eating

B1. How important is it for you to eat healthy?

Not at all important

Not important

Neutral

Important

Very Important

B2. In your opinion, how would you describe the quality of your current diet?

Bad

Poor

Fair

Good

Excellent

### Section C Dietary Habits

This section is about your usual eating habits. When answering these questions please think back over the past 4 weeks. Remember to think about all meals (that is breakfast, lunch and dinner) as well as snacks and times when you eat both at home and away from home. [2008/09 New Zealand Adult National Nutrition Survey questions]

C1. How many days a week on average do you skip or miss a main meal such as breakfast, lunch, or dinner? Do not count when you replace this meal with smoothies/shakes, or snacks.

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

C2. On average, how many slices of bread/toast OR bread rolls do you eat per day?

None, I don't eat bread or toast

Less than one per day

1-2 per day

3-4 per day

5-6 per day

7 or more per day

Don't know

C3. What type of bread, rolls or toast do you eat most of?

White

High fibre white

Light grain bread (e.g. Molenberg, Freya's, Ploughmans, And MacKenzie High Country)

Heavy grain bread (e.g. Vogels and Burgen)

Other

Don't know

C4. In the past four weeks which of the following have you eaten at least once? (you can chose more than 1)

Red meat - such as beef, pork, mutton, lamb and goat

Chicken - such as chicken breast, drumsticks, or whole chickens

Processed meats - such as ham, bacon, sausages, luncheon, canned corned beef, pastrami, and salami.

Seafood - such as fish or shellfish

None

Don't know

C5. How often do you eat red meat per week (beef, lamb, pork, mutton, goat)?

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

C6. How often do you remove fat from meat? (*before or after cooking, and before eating*)

Never

Rarely

Sometimes

Regularly

Always

Don't know

C7. How often do you remove skin from chicken? (*you buy skinless cuts or remove before or after cooking, and before eating*)

Never

Rarely

Sometimes

Regularly

Always

Don't know

C8. How often do you eat processed meat products? *Processed meat includes ham, bacon, sausages, luncheon, canned corned beef, pastrami, and salami*

Never

Less than once per week

- 1-2 times per week
- 3-4 times per week
- 5-6 times per week
- 7 or more times per week
- Don't know

C9. How often do you eat fresh, frozen, or canned fish or shell fish on an average week?

- Never
- Less than once per week
- 1-2 times per week
- 3-4 times per week
- 5-6 times per week
- 7 or more times per week
- Don't know

C10. On average how many servings of fruit - fresh, frozen, canned or stewed - do you eat per day? *A serving is the same as a medium piece of fruit such as an apple or two small pieces of fruit such as two apricots, or half a cup of stewed fruit.*

- Never, I don't eat fruit
- Less than one serving per day
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings
- Don't know

C11. On average how many servings of vegetables - fresh, frozen or canned - do you eat per day? *Do not include vegetable juices. A serving is the same as one potato/kumara, half a cup of peas or a cup of salad. For example, 2 medium potatoes + 1/2 cup of peas = 3 servings*

- Never, I don't eat vegetables
- Less than one serving per day

1 serving

2 servings

3 servings

4 or more servings

Don't know

C12. What type of milk do you use the most of?

None, I don't use milk

Whole or standard cows milk (Dark blue or silver lid)

Reduced fat cows milk (light blue, green or yellow lid)

Almond milk.

Soy milk.

Coconut milk.

Rice milk

Other (other animal milk e.g. goats milk, sheep milk, or other nut milk e.g. cashew milk, macadamia milk)

Don't know

B17. What type of spread do you use the most of?

None, I don't use spread on breads or other foods

Butter

Butter and margarine blend

Margarine (eg Canola, Sunflower, and Olive oil based)

Lite or reduced fat margarine (eg Canola, Sunflower, and Olive oil based)

Oil e.g. olive oil, rice bran oil

Don't know

B18. What type of fat or oil is used most often in cooking and preparing your food?

None, I don't use fat or oil

Butter

Margarine

Butter and margarine blend

Oil

Dripping or Lard

Other

Don't know

B19. How often do you add salt to your food after it has been cooked or prepared?

Never

Rarely

Sometimes

Regularly

Always

Don't know

B20. How often do you choose low or reduced fat varieties of foods instead of the standard variety?

Never

Rarely

Sometimes

Regularly

Always

Don't know

B21. How often do you choose low or reduced salt varieties of foods instead of the standard variety?

Never

Rarely

Sometimes

Regularly

Always

Don't know

B22. How often do you eat fast food or takeaways from places like McDonalds, Burger King, KFC, Chinese, Indian, Noodle Canteen etc on an average week. *Think about breakfast, lunch, dinner and snacks. Do not include times when you have only purchased a drink/beverage.* [modified using Tanton et al, 2015]

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

B23. How often would you eat food or takeaways from a sit-down or family-style restaurant, café, pub. on an average week. *Think about breakfast, lunch, dinner and snacks. Do not include times when you have only purchased a drink/beverage.* [modified using Tanton et al, 2015]

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

B24. How often would you eat a convenience meal (*e.g. instant noodles, microwave meals, frozen pizza, chicken nuggets*) on an average week? [modified using Tanton et al, 2015]

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

B25. How often do you drink fruit juices and fruit drinks such as Just Juice, Fresh-up, Keri, Golden Circle, Ribena, McCoy and Charlie's.

Never

Less than once per week

1-2 times per week



3-4 times per week

5-6 times per week

7 or more times per week

Don't know

B26. How often do you drink sugar-sweetened beverages? Do not include diet varieties.

(Soft drinks are often carbonated or 'fizzy' and include Coca-cola, Pepsi, Lemonade, Ginger beer, Energy drinks (e.g. 'V', Red Bull, Lift plus), Powerade, E2 and G-force.

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

B27. How often do you eat lollies, sweets, chocolate and confectionary?

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

B28. How often do you eat sweet snack foods like pastries, cakes, slices, muffins, cookies?

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

B28. How often do you eat savory commercial snack foods like potato chips, crisps, corn chips/snacks, cheese snacks?

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

## Section D Dietary Supplements

Now a few questions on dietary supplements. For these questions please think back over the past 12 months.

D1. Did you take any supplements at any time during the last 12 months?

Yes

No

D2. Which did you take?

Multivitamin and multimineral

Multivitamins

Multimineral

Single vitamin and/or single mineral

Oil

Other supplement

Unsure of classification

D3. Can you please tell me the names OR do you still have the supplement container?

## UPLOAD PHOTOGRAPHS

D4. Was it prescribed to you by a doctor/nurse practitioner

Yes

No

D5. How often did you take the supplement in the last 12 months?

Daily

More than once per week

Once per week

Monthly

Episodic (REGULAR use but for a limited time period)

Infrequent and irregular use

Other

Don't know

## Section E Health

The next section of this questionnaire is about health behaviours. This includes questions on lifestyle factors that can influence your health.

E1. Have you ever restricted what you eat to purposely lose weight?

Yes

No

E2. If you have dieted in the past, please indicate the number of times you have lost 5 or more kg

\_\_\_\_\_

E31. On how many nights of the past week did you get enough sleep so that you felt rested when you woke up in the morning?

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 times per week

Don't know

E4. On how many days of the past week did you participate in moderate exercise for at least 30 minutes?

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

E5. On how many days of the past week did you participate in vigorous exercise for at least 15 minutes?

Never

Less than once per week

1-2 times per week

3-4 times per week

5-6 times per week

7 or more times per week

Don't know

E6. Have you ever smoked a total of more than 100 cigarettes in your whole life?.

Yes

No [Go straight to question E10]

E7. How often do you currently smoke?

I don't smoke now [Skip to Question E10]

At least once a day

At least once a week

At least once a month

Less often than once a month

E8. On average, how many cigarettes do you smoke a day?

Round answer to nearest number if necessary e.g. 2.5 cigarettes a day should be entered as 3.

E9. How long ago did you stop smoking?

Within the last month

1 month to 6 months ago

6 to 12 months ago

1 to 2 years ago

2 to 5 years ago

Longer than 5 years ago

E10. How often do you have a drink containing alcohol?

[World Health Organization's Alcohol AUDIT screening tool]

Never [Skip to Section F]

Monthly or less

2 to 4 times a month

2 to 3 times a week

4 or more times a week

E11. How many drinks containing alcohol do you have on a typical day when you are drinking?

1 or 2 [Skip to Section D Food Accessibility and Preparation]

3 or 4

5 or 6

7, 8, or 9

10 or more

E12. How often do you have six or more drinks on one occasion?

Never

Less than monthly

Monthly

Weekly

Daily or almost daily

## Section F Food Accessibility and Preparation

The fourth section of this questionnaire is about access to food and food preparation and cooking skills.

Food preparation skills. Food preparation skills may affect diet quality and healthy eating. We are interested in your skills such as cooking from scratch or following a recipe.

F1. Do you do your own grocery food shopping/share grocery food shopping?

Yes

No

F2. Where do you purchase the majority of your grocery food shopping?

F3. Do you do cook your own meals/share cooking responsibilities?

[Minkow, S 2016 thesis]

Yes

No [Skip to question F9]

F4. Do you have a kitchen at your residence?

Yes

No

F5. How confident do you feel using basic cooking techniques (such as steaming, sautéing, roasting)?

Extremely confident

Confident

Neutral

Not very confident

Not at all confident

F6. How confident do you feel preparing vegetables?

Extremely confident

Confident

Neutral

Not very confident

Not at all confident

F7. How confident do you feel trying a new recipe?

Extremely confident

Confident m Neutral

Not very confident

Not at all confident

Now we will ask you about when you are eating on campus. When answering these questions please think back over the past 4 weeks.

F8. How often during a normal week do you bringing food from home to eat on campus?

Never

Less than once per week

1-2 times per week

3-4 times per week

5 times per week

F9. How often during a normal week do you buy food from student cafeteria, café, or Food cart?

Never

Less than once per week

1-2 times per week

3-4 times per week

5 times per week

F10. How often during a normal week do you buy vending machine food or beverage on campus?

Never

Less than once per week

1-2 times per week

3-4 times per week

5 times per week

Don't know

## Section G Food Security

[2008/09 New Zealand Adult

National Nutrition Survey questions]

I now want to ask you some questions about particular foods you choose, and the buying of food or gifting of food. We are interested in whether you feel you always have sufficient resources to have the food you need for yourself and the people you live with. We are not concerned with your budget, or how you spend money, but we are more interested in finding out about how people get the food that they need for their household to eat and share. First of all, we know that some people can't afford to eat properly and we are interested in whether you think you can or can't afford to eat properly. It is what you think eating properly is.

G1. I/We can afford to eat properly

Always

Sometimes

Never

Don't Know

We are interested in whether you run out of basics, like bread, potatoes, etc, because you do not have enough money. We are NOT referring to treats or special foods.

G2. Food runs out in my/our household due to lack of money. How often has this been true for you (or your household) over the past year?

Often

Sometimes

Never



Don't Know

Now we are interested in whether a lack of money leads you to sometimes have smaller meals than you would like or whether a lack of money means there is not enough for seconds or you sometimes skip meals?

G3. I/We eat less because of lack of money. How often has this been true for you (or your household) over the past year?

Often

Sometimes

Never

Don't Know

Now we are going to talk about the variety of foods you eat. By variety, we mean the number of different kinds of foods you have.

G4. The variety of foods I am/we are able to eat is limited by a lack of money. How often has this been true for you (or your household) over the past year?

Often

Sometimes

Never

Don't Know

Some people rely on support and assistance from others for supplying their regular food and we are interested in finding out how many people fall into this group.

G5. I/We rely on others to provide food and/or money for food, for my/our household, when I/we don't have enough money. How often has this been true for you (or your household) over the past year?

Often

Sometimes

Never

Don't Know

Also, some people have to rely on other sources of help such as food grants or food banks.

G6. I/We make use of special food grants or food banks when I/we do not have enough money for food. How often has this been true for you (or your household) over the past year?

Often

Sometimes

Never

Don't Know

We know that some people get quite stressed and worried about providing enough food even though they don't actually go without food.

G7. I feel stressed because of not having enough money for food. How often has this been true for you (or your household) over the past year?

Often

Sometimes

Never

Don't Know

We recognise that for some people food and sharing food with others is important, to the point that they won't have enough food for themselves. In this question we are only interested in social situations which are gatherings within, or outside, the household. As a result people may find themselves stressed/whakama (embarrassed) about their koha (gift) when providing food for others.

G8. I feel stressed because I can't provide the food I want for social occasions. How often has this been true for you (or your household) over the past year?

Often

Sometimes

Never

Don't Know

## Section H Demographics

We'd like to finish with some basic demographic questions.

H1. What is your gender?

H2. What is your age?

H3. Which ethnic group or groups do you identify with?

New Zealand European/Pakeha

Maori

Samoa

Cook Island Maori

Tongan

Niuean

Chinese

Indian

Other, such as Dutch, Japanese, Tokelauan

H3b. If you answered other, what other ethnicity or ethnicities do you identify with?

\_\_\_\_\_

H4. Which country were you born in?

New Zealand

Australia

England

Scotland

China (People's Republic of)

South Africa

Samoa

Cook Islands

Other

H4b. Specify current name of country \_\_\_\_\_

H4c. If you were born outside of NZ, what year did you arrive to live in New Zealand? \_\_\_\_\_

H5. What is your Study Discipline/s? \_\_\_\_\_

H6. What is your Year of Study?

100 level (first year)

200 level

300 level

400 level

700 level (post grad)

Additional socio-demographics

Now, I am going to ask you some general questions about you and your household.

H7. Please describe your living situation. Are you living?

On-Campus Dormitory/Halls of Residence

On-campus apartment

Off-Campus House

Off-Campus Apartment

H8. Which of these people live in the same household (*including the unit in the dormitory or apartment block but not the whole dormitory or apartment block*) as you?

My legal husband, wife or civil union partner

My partner or de facto, boyfriend or girlfriend

My son(s) and/or daughter(s), or partner's son(s) or daughter(s)

My mother and/or father, or parent's spouse or partner

My sister(s) and/or brother(s)

My flatmate(s)

Boarder/family you are boarding with

None of the above, I live by myself

Other

H9. How many people live in your household, INCLUDING yourself and any babies and children?

The next few questions ask about your sources of income.

H10. Which of these statements best describes your current work and study situation:

Study and work commitments

study part time and work full time

study part time and work part time

study full time and work part time

study full time with no work

H11. What is the total income that you yourself got from all sources, before tax or anything was taken out of it, in the last 12 months?

Less than \$5,000

\$5,001 - \$10,000

\$10,001 - \$15,000

\$15,001 - \$20,000

\$20,001 - \$25,000

\$25,001 - \$30,000

\$30,001 - \$40,000

\$40,001 - \$50,000

\$50,001 - \$60,000

\$60,001 - \$70,000

\$70,001 - \$80,000

\$80,000 - \$100,000

\$100,001 or more

Prefer not to say

## Appendix B: Scoring of Dietary Guideline Index

**Table 1.** Components and scoring methods of the Dietary Guideline Index used in the current study

DGI Component	Component Scoring Criteria*		
	Criteria for Minimum Score	Criteria for Maximum Score	Maximum score
Fruit intake servings per day	0	≥2	10
Vegetable intake servings per day	0	≥3	10
Grain foods intake servings per day	0	≥6	5
Wholegrain foods intake Type of bread usually consumed	White bread	Heavy grain bread	5
Alcohol intake servings per day drinking occasion	>4 standard drinks/day for women >5 standard drinks/day for men	≤1-2 standard drinks/drinking day	10
Saturated fat intake Removal of fat from meat † Type of milk usually consumed	Never Whole-fat milk	Always- regularly Reduced-fat varieties such as trim milk	5 5
Added sugar intake Frequency of juice consumption Frequency of sugar sweetened beverage consumption Frequency of candy/sweets consumption Frequency of confectionary/pastries consumption	≥3-4 times per week ≥3-4 times per week ≥3-4 times per week ≥3-4 times per week	Less than once per week/Never Less than once per week/Never Less than once per week/Never Less than once per week/Never	2.5 2.5 2.5 2.5
Added salt intake Salt added at the table Choosing low salt variety foods	Always Never	Rarely/Never Regularly/Always	5 5
'Extra' food intake** Frequency of convenience meal consumption Frequency of commercial snack food consumption	≥3-4 times per week ≥3-4 times per week	≤1-2 times per week ≤1-2 times per week	5 5
Total DGI Score			80

\*for more detail on how each component was scored, refer to Appendix A.

† Non meat eaters were allocated the maximum score

\*\*Extra foods include foods not essential in providing nutrient requirements such as high-sugar foods, chips, muffins, pastry, convenience meals, commercial snack foods.

**Table 2.** Summary of DGI components between Thorpe et al. and the current study

Dietary component	Score	
	Thorpe et al.	EATS
Variety	10	-

Fruit	10	10
Vegetables	10	10
Cereals/Grains	10	10
Lean meat	10	-
Dairy/Reduced fat	10	-
Alcohol	10	10
Saturated fat	10	10
Added sugars	10	10
Added salt	10	10
Fluid	10	-
'Extra'(Discretionary) foods	10	10
Unsaturated oils	10	-
<b>Total</b>	<b>130</b>	<b>80</b>

### Fruit intake

C10/Q14: On average how many servings of fruit - fresh, frozen, canned or stewed - do you eat per day? A serving is the same as a medium piece of fruit such as an apple or two small pieces of fruit such as two apricots, or half a cup of stewed fruit.

- Never, I don't eat fruit (0)
- Less than one serving per day (0)
- 1 serving (5)
- 2 servings (10)
- 3 servings (10)
- 4 or more servings (10)
- Don't know (0)

### Vegetable intake

C11/Q15: On average how many servings of vegetables - fresh, frozen or canned - do you eat per day? Do not include vegetable juices. A serving is the same as one potato/kumara, half a cup of peas or a cup of salad. For example, 2 medium potatoes + ½ cup of peas = 3 servings

- Never, I don't eat vegetables (0)
- Less than one serving per day (0)
- 1 serving (2)
- 2 servings (6)
- 3 servings (10)
- 4 or more servings (10)
- Don't know (0)

### Grain foods intake

C1/Q6: On average, how many slices of bread/toast OR bread rolls do you eat per day? (Cereal intake)

- None, I don't eat bread or toast (0)
- Less than one per day (1)
- 1-2 per day (2)
- 3-4 per day (3)
- 5-6 per day (5)
- 7 or more per day (5)

- Don't know (0)

C3/Q7: What type of bread, rolls or toast do you eat most of?

- White (0)
- High fibre white (2)
- Light grain bread (e.g. Molenberg, Freya's, Ploughmans, And MacKenzie High Country) (3)
- Heavy grain bread (e.g. Vogels and Burgen) (5)
- Other (3)
- Don't know (0)

#### Saturated fat intake

C6/Q10: How often do you remove fat from meat? (before or after cooking, and before eating) – Non-meat eaters score 5

- Never (0)
- Rarely (0)
- Sometimes (3)
- Regularly (5)
- Always (5)
- Don't know (0)

C12/Q16: What type of milk do you use the most of?

- None, I don't use milk (5)
- Whole or standard cows milk (Dark blue or silver lid) (0)
- Reduced fat cows milk (light blue, green or yellow lid) (5)
- Almond milk. (5)
- Soy milk. (5)
- Coconut milk. (0)
- Rice milk (5)
- Other (other animal milk e.g. goats milk, sheep milk, or other nut milk e.g. cashew milk, macadamia milk) (3)
- Don't know (0)

#### Alcohol intake

E11/Q45: How many drinks containing alcohol do you have on a typical day when you are drinking?

- 1 or 2 (10)
- 3 or 4 (6) (5)
- 5 or 6 (2) (0)
- 7, 8, or 9 (0)
- 10 or more (0)

According to recommendations for **men** and **women**

\* if participant indicated they do not drink in E10/Q44, then gets score of 10 in this variable

#### Added sugar intake



B25/Q25: How often do you drink fruit juices and fruit drinks such as Just Juice, Fresh-up, Keri, Golden Circle, Ribena, McCoy and Charlie's.

- Never (2.5)
- Less than once per week (2.5)
- 1-2 times per week (1)
- 3-4 times per week (0)
- 5-6 times per week (0)
- 7 or more times per week (0)
- Don't know (0)

B26/Q26: How often do you drink sugar-sweetened beverages? Do not include diet varieties.(Soft drinks are often carbonated or 'fizzy' and include Coca-cola, Pepsi, Lemonade, Ginger beer, Energy drinks (e.g. 'V', Red Bull, Lift plus), Powerade, E2 and G-force.

- Never (2.5)
- Less than once per week (2.5)
- 1-2 times per week (1)
- 3-4 times per week (0)
- 5-6 times per week (0)
- 7 or more times per week (0)
- Don't know (0)

B27/Q27: How often do you eat lollies, sweets, chocolate and confectionary?

- Never (2.5)
- Less than once per week (2.5)
- 1-2 times per week (1)
- 3-4 times per week (0)
- 5-6 times per week (0)
- 7 or more times per week (0)
- Don't know (0)

B28/Q28 How often do you eat sweet snack foods like pastries, cakes, slices, muffins, cookies?

- Never (2.5)
- Less than once per week (2.5)
- 1-2 times per week (1)
- 3-4 times per week (0)
- 5-6 times per week (0)
- 7 or more times per week (0)
- Don't know (0)
- 

Added salt intake

B19/Q19: How often do you add salt to your food after it has been cooked or prepared?

- Never (5)
- Rarely (5)
- Sometimes (3)
- Regularly (0)

- Always (0)
- Don't know (0)

B21. How often do you choose low or reduced salt varieties of foods instead of the standard variety?

- Never (0)
- Rarely (0)
- Sometimes (3)
- Regularly (5)
- Always (5)
- Don't know

'Extra' food intake\*

B24/Q24: How often would you eat a convenience meal (e.g. instant noodles, microwave meals, frozen pizza, chicken nuggets) on an average week? [modified using Tanton et al, 2015]

- Never (5)
- Less than once per week (5)
- 1-2 times per week (5)
- 3-4 times per week (2)
- 5-6 times per week (0)
- 7 or more times per week (0)
- Don't know (0)

B28/Q29: How often do you eat savory commercial snack foods like potato chips, crisps, corn chips/snacks, cheese snacks?

- Never (5)
- Less than once per week (5)
- 1-2 times per week (5)
- 3-4 times per week (2)
- 5-6 times per week (0)
- 7 or more times per week (0)

## Appendix C: Supplementary Results

**Supplementary Table 1.** Descriptive statistics for each component of DGI

	<i>n</i> *	%	DGI Score	
			Mean	Range
Servings of fruit per day				
Less than one serving	3	7.5	50.7	49-53
1 serving	10	25	47.3	22-60.5
2 servings	11	27.5	57.4	38-75
3 servings	11	27.5	57.9	48-72
4 or more servings	5	12.5	55.0	48.5-70.5
Servings of vegetables per day				
1 serving	6	15.4	40.7	22-50.5
2 servings	11	28.2	56.2	48.5-70.5
3 servings	10	25.6	56.9	48-75.0
4 or more servings	12	30.8	58.4	48-72
Slices of bread/toast or bread rolls per day				
None	4	10.5	52.6	48-58
Less than one per day	10	26.3	54.3	38-72
1-2 per day	19	50	54.5	22-75
3-4 per day	5	13.2	56.3	50-70.5
Type of bread/toast or rolls most eaten				
White	4	10	46.1	22-57
Light grain bread	15	37.5	53.1	34-72
Heavy grain bread	12	30	56.6	41.5-72
Other	9	22.5	56.4	42.5-75
Removing fat from meat				
Never	4	10	53.1	48.5-61
Rarely	7	17.5	45.9	22-53
Sometimes	9	22.5	49.3	38-59
Regularly	4	10	61.0	55.5-72
Always	12	30	60.7	51-75
Don't know	4	10	54.3	34-72
Type of milk most frequently used				
Whole or standard cows milk	16	43.3	49.3	22-67.5
Reduced fat cows milk	8	21.6	55.2	34-72
Almond milk	7	18.9	58.9	52-72
Soy milk	3	8.1	60.1	52.5-69
Coconut milk	3	8.1	51.1	48-57.5
Number of alcoholic drinks consumed on a typical day drinking				
1 or 2	13	36.1	57.8	48.5-75
3 or 4	15	41.7	55.4	42.5-69
5 or 6	8	22.2	45.4	22-63.5
Frequency of fruit juice/drink intake				
Never	21	55.3	58.0	34-75
Less than once per week	9	23.7	52.1	41.5-59
1-2 times per week	6	15.7	51.6	38-70.5
3-4 times per week	2	5.3	49.5	48.5-50.5
Frequency of sugar-sweetened beverage intake				

Never	17	43.6	60.1	48-75
Less than once per week	15	38.4	52.6	34-70.5
1-2 times per week	7	18.0	47.8	38-55
Frequency of confectionary intake				
Never	2	5.1	67.2	64-70.5
Less than once per week	15	38.5	57.3	38-75
1-2 times per week	10	25.6	50.8	34-63.5
3-4 times per week	8	20.5	47.6	22-59.5
7 or more times per week	4	10.3	56.1	49-67.5
Frequency of sweet snack food intake				
Less than once per week	22	57.9	58.5	38-75
1-2 times per week	11	28.9	46.2	22-53.5
3-4 times per week	5	13.2	53.1	49-57.5
Frequency of adding salt to food that has been already cooked/prepared				
Never	5	12.5	64.9	52.5-75
Rarely	13	32.5	55.7	41.5-72
Sometimes	9	22.5	56.3	49-69
Regularly	7	17.5	48.1	22-59.5
Always	6	15	46	34-52.5
Choosing low or reduced salt varieties of food instead of standard variety				
Never	6	15.4	49.0	41.5-52.5
Rarely	11	28.2	47.4	22-61
Sometimes	13	33.3	55.6	48-70.5
Regularly	7	18.0	67.8	55.5-75
Always	2	5.1	55.7	52.5-59
Frequency of convenience meals				
Never	29	74.4	57.2	48-75
Less than once per week	6	15.4	42.2	22-52.5
1-2 times per week	4	10.2	49.5	34-67.5
Frequency of commercial snack food intake				
Never	2	5.1	60.2	57-73.5
Less than once per week	18	46.1	59.4	48-75
1-2 times per week	12	30.8	48.0	22-72
3-4 times per week	7	18.0	50.3	34-61

\*total *n* varies between measures due to missing responses

**Supplementary Table 2.** Mean Diet Guideline Index Scores according to key characteristics of a sample of university students

	<i>n</i> *	%	DGI Score		<i>P</i> value†
			Mean	SD	
Sex					
Male	14	35	50.7	12.13	0.13
Female	26	65	56.1	9.36	
Ethnicity					
NZE/Pakeha	28	71.8	53.9	11.61	0.65
Maori	2	5.1	46.5	12.02	
Asian	4	10.3	68.4	9.20	
Other	5	12.8	55.4	5.51	

Country of birth					
New Zealand	26	66.7	55.0	11.65	0.40
England	2	5.1	43.0	12.73	
South Africa	3	7.7	56.3	6.37	
Other	8	20.5	51.6	4.26	
Study Discipline					
Non-health	20	50	51.6	11.48	0.12
Health	20	50	56.8	9.13	
Level of study					
100 level	5	12.8	53.0	3.89	0.98
200 level	8	20.5	52.6	16.87	
300 level	11	28.2	53.4	12.08	
400 level	2	5.2	56.2	10.96	
700 level (post-graduate)	13	33.3	55.3	6.99	
Who do you live with					
Flatmates	24	60	54.9	8.30	0.63
Family	16	40	53.2	13.54	
Living situation					
On campus dorm/off campus apartment	6	15	53.4	4.92	0.85
At home	34	85	54.3	11.33	
Work and study arrangement					
Study part time and work part time	8	20.5	54.7	6.80	0.96
Study full time and work part time	19	48.7	54.6	10.24	
Study full time with no work	12	30.8	53.4	13.92	

---

\*total  $n$  varies between measures due to missing responses

†One-way ANOVA

ferences

**Supplementary Table 3.** Mean Diet Guideline Index Scores according to food beliefs and behaviours in a sample of university students

	<i>n</i> *	%	DGI Score		<i>P</i> value†
			Mean	SD	
Importance of eating healthy					
Neutral	3	7.5	50.7	1.76	<0.01
Important	18	45	48.1	9.61	
Very important	19	47.5	60.5	8.54	
Perception of diet quality					
Poor/fair	18	45	48.0	9.70	<0.01
Good/excellent	22	55	59.2	8.50	

\*total *n* varies between measures due to missing responses

†One-way ANOVA

**Table 4.** Mean Diet Guideline Index Scores according to risky and health promoting behaviours

	<i>n</i> *	%	DGI Score		<i>P</i> value†
			Mean	SD	
Supplement taken in the past 12 months					
Yes	32	80	54.7	11.20	0.58
No	8	20	52.3	7.94	
Type of supplement taken					
Multivitamin and multimineral	6	20	54.6	19.16	1.00
Multivitamin	3	10	55.0	4.50	
Single vitamin and/or single mineral	9	30	53.7	8.68	
Oil	5	16.7	54.5	11.09	
Amino acid/protein supplement	7	23.3	54.6	10.15	
Frequency of supplement intake					
Infrequent/episodic	18	45	48.8	10.17	<0.01
Frequent/regular	22	55	58.6	8.84	
History of restrictive eating with the intention of losing weight					
Yes	18	45	51.6	8.92	0.16
No	22	55	56.3	11.53	
Getting enough sleep					
Less than 5 times per week	25	64.1	52.8	9.83	0.26
At least 5 times per week	14	35.9	56.8	12.07	
Participating in moderate exercise for at least 30 minutes					
Never	2	5.2	64.7	8.13	0.03
Less than once per week	2	5.2	50.5	2.12	
1-2 times per week	9	23.7	53.7	5.54	
3-4 times per week	15	39.5	49.7	12.89	
5-6 times per week	10	26.3	61.6	7.12	
Smoked a total of more than 100 cigarettes					
Yes	6	15	49.2	8.57	0.22
No	34	85	55.1	10.77	

ferences

Frequency of alcoholic drink consumption

Never	3	7.7	60.3	9.08	0.28
Monthly or less	15	38.4	67.4	8.42	
2-4 times a month	14	35.9	51.0	14.24	
2-3 times a week	7	18.0	51.9	3.97	

Number of alcoholic drinks consumed on a typical day drinking

1 - 4 drinks	28	77.8	56.5	8.46	<0.01
5 - 6 drinks	8	22.2	45.4	13.19	

\*total *n* varies between measures due to missing responses

†One-way ANOVA

**Supplementary Table 5.** Mean Diet Guideline Index Scores according to food security variables in a sample of university students

	<i>n</i> *	%	DGI Score		<i>P</i> value†
			Mean	SD	
Afford to eat properly					
Always	29	72.5	54.8	11.7	0.55
Sometimes	11	27.5	52.5	7.00	
Food runs out in my/our household due to lack of money					
Often	2	5.1	43.0	7.07	0.16
Sometimes	8	20.5	58.0	6.53	
Never	29	74.4	53.2	10.67	
Variety of foods is limited due to lack of money					
Never	19	47.5	55.8	9.46	0.37
At least sometimes	21	52.5	52.7	11.53	
Reliance of external sources of food or funding for food					
Often	2	5	54.2	8.83	0.98
Sometimes	4	10	53.4	4.85	
Never	34	85	54.3	11.30	
Feeling stressed because of not having enough money for food					
Often	2	5	54.0	2.12	0.86
Sometimes	12	30	55.6	8.81	
Never	26	65	53.5	11.78	
Gross Income in the past 12 months					
\$15,000 or less	15	41.7	53.7	13.47	0.65
over \$15,000	21	58.3	55.4	8.89	

\*total *n* varies between measures due to missing responses

†One-way ANOVA

ferences

**Supplementary Table 6.** Mean Diet Guideline Index Scores according to food accessibility and preparation variables in a sample of university students

	<i>n</i> *	%	DGI Score		<i>P</i> value†
			Mean	SD	
Do your own grocery shopping					
Yes	31	77.5	56.5	9.17	<0.01
No	9	22.5	46.1	11.63	
Where is the majority of your food sourced from					
Chain supermarket	34	89.5	54.1	11.33	0.96
Green grocer	2	5.3	52.0	1.41	
Meal delivery service	2	5.3	54.7	8.83	
Cook your own meals					
Yes	6	15	42.9	13.24	<0.01
No	34	85	56.2	8.86	
Bringing food from home to eat on campus					
1-2 times per week or less	17	42.5	50.9	11.92	0.09
At least 3-4 times per week	23	57.5	56.6	8.97	
Buying food from student cafeteria, café or food cart					
1-2 times per week or less	35	87.5	54.0	10.84	0.81
At least 3-4 times per week	5	12.5	55.3	9.56	
Buying food/beverages from the vending machine on campus					
1-2 times per week or less	37	92.5	54.1	10.83	0.83
At least 3-4 times per week	3	7.5	55.5	10.40	
Confidence in using basic cooking techniques					
Not confident	14	35	49.7	11.47	0.05
Confident	26	65	56.6	9.43	
Confidence in preparing vegetables					
Not confident	10	25	52.7	8.45	0.62
Confident	30	75	54.7	11.28	
Confidence in trying a new recipe					
Extremely confident	10	25	53.8	6.94	0.91
Confident	30	75	54.3	11.64	

\*total *n* varies between measures due to missing responses

†One-way ANOVA