Disordered Eating Attitudes and Behaviours in Students Undertaking Tertiary Training in Nutrition and Dietetics

Tetyana Rocks

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Disordered Eating Attitudes and Behaviours in Students Undertaking Tertiary Training in Nutrition and Dietetics

This thesis submitted in fulfilment of the requirements for the degree of

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Tetyana Rocks
BNutDiet., BSc(Hon)

Under supervision of
Associate Professor Fiona Pelly
Dr Gary Slater
Dr Lisa Martin

Nutrition and Dietetics
School of Health and Sport Sciences
Faculty of Science, Health and Engineering

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Abstract

Modern society is preoccupied with physical appearance. It is well accepted that a focus on appearance may negatively influence body image and lead to maladaptive behaviours such as disordered eating. Nutritionists and dietitians are often viewed as role models for eating- and body-related attitudes and behaviours. Students studying nutrition and dietetics (ND) have also previously reported a perceived pressure to appear and act in a certain way. It has also been suggested that some ND students may have chosen this study area due to a motivation to deal with pre-existing disordered eating- and weight-related issues. This hypothesis has led to several studies in this population being conducted to investigate the prevalence of disordered eating behaviours and negative body image. These studies have produced mixed outcomes, with some suggesting that ND students may be at greater risk, whilst others concluded that this group are no different to similar cohorts of university students. Furthermore, there is currently little evidence on the influence of ND tertiary training on the eating and body attitudes of students. Therefore, the aims of this research were: 1) To describe eating attitudes and behaviours of students undertaking tertiary training in ND degrees, 2) To explore associations between the eating attitudes and behaviours and other psychological and physiological factors, and 3) To examine the change in eating attitudes and behaviours of ND students over one year of university study.

Participants of this research were undergraduate students of both sexes across all years of study at the University of the Sunshine Coast, Queensland Australia. Students were enrolled in a four-year professionally accredited nutrition and dietetics degree and a three-year non-accredited nutrition degree. Graduates from the professionally accredited degree can practice as accredited dietitians, whilst graduates from nutrition degree can work as nutritionists or nutrition scientists. Students enrolled in another four-year professionally accredited female-dominated allied health degree (occupational therapy, OT) acted as a control. Data were collected at two stages, 12 months apart. At both stages, a range of measures related to eating attitudes and behaviours, exercise attitudes and behaviours, self-esteem, body shape satisfaction and dietary preferences were collected through online questionnaires using previously validated tools. Following the completion of the online surveys, body composition and resting metabolic rate were measured.
Additionally, dietary intake information was collected over the course of these assessments. A total of 165 students from three degrees participated in various components at the first stage of data collection (n = 109 students enrolled in the two nutrition-focused degrees, combined as the ND cohort, and n = 56 of the OT cohort). Of these, 40 students (n = 30 ND and n = 10 OT) completed the follow-up data collection at stage two.

The aims of this research were investigated through four phases of data analysis. The outcomes were subsequently presented in four papers. The initial phase utilised information obtained during the first stage of data collection. This information was used to describe eating attitudes and behaviours of students enrolled in ND courses. The analysis then explored relationships of those attitudes and behaviours to socio-demographic and diet-related influences. Additionally, eating attitudes and behaviours of ND (n = 91) and OT (n = 46) students were compared. The results revealed that 14% of ND students had eating attitudes symptomatic of an eating disorder. This result was similar to the OT cohort and is similar to prevalence reported in other student populations. Furthermore, 41% of ND students followed a dietary regimen, 52% avoided certain foods in their diet, while 56% exercised for more than an hour per day to control their body weight. Students enrolled in the first year of their studies exhibited similar eating attitudes and behaviours to those enrolled in subsequent years. However, the proportion of individuals following a dietary regimen was greater in the first year students. Additionally, enrolment in the first year of ND study was a significant predictor of disordered eating attitudes. The majority of ND students across all the years of study expressed a desire to weigh less, yet 77% had a Body Mass Index ≤ 25.0 kg/m². Comparisons made between ND and OT students suggested that although both cohorts were similar in disordered eating attitudes and uncontrolled eating, a greater proportion of ND students demonstrated cognitive restraint. Emotional eating, however, was found to impact a smaller proportion of the ND cohort.

The second aim of the project explored associations between the eating attitudes and behaviours and other psychological and physiological factors. This was completed during phase two and three of data analysis. Phase two examined energy and macronutrient intake in participants, and investigated relationships between eating attitudes and
behaviours and energy status. Assessment of the dietary intake of the ND cohort suggested that energy and macronutrient intake was not related to disordered eating attitudes or high cognitive restraint. However, 18% out of the 50 ND students presented with a low energy availability (< 30 kcal (< 126 kJ) per kilogram of fat free mass per day) and 38% were in negative energy balance. Amongst females, students with high cognitive restraint had greater exercise energy expenditure than those with low cognitive restraint. Consequently, energy availability was also lower in females with high cognitive restraint compared to those with low cognitive restraint (35 (7) kcal (147 (29) kJ) compared to 41 (10) kcal (172 (42) kJ) of fat free mass, \( P = 0.005 \)). Overall, in female ND students, disordered eating attitudes and cognitive restraint correlated with energy availability \( (r_s = -0.37, P = 0.02 \) and \( r_s = -0.51, P < 0.01 \) respectively). The results of this study showed an association between disordered eating attitudes and cognitive restraint and suboptimal energy status relative to energy required for exercise in ND females.

Exercise attitudes and the relationship between eating and exercise attitudes and behaviours were investigated in the third phase of analysis. This phase used self-reported and measured data collected at the first stage of this research. The outcomes demonstrated that the majority of ND students of both sexes who have participated in this study (94%, \( n = 91 \)) reported some symptoms of exercise addiction, whilst 23% (35% of males and 20% of females) were identified as at risk for exercise addiction. A direct correlation was observed between problematic exercise attitudes and disordered eating and cognitive restraint \( (r_s = 0.30, P = 0.004, \) and \( r_s = 0.25, P = 0.016 \) respectively). In ND females, students with symptoms of an eating disorder and high cognitive restraint had greater exercise addiction scores and reported higher volumes of exercise. These trends were not apparent in the ND males. There were no differences in the measurements of exercise attitudes and behaviours between ND and OT students. The outcomes of this investigation suggested that supportive and preventative mechanisms developed to assist undergraduate students should include education on excessive exercise and exercise addiction.

The final aim of this research was to examine the change in eating attitudes and behaviours of ND students over one year of university study. This was investigated during the fourth phase of data analysis. This phase utilised information from both stages of data
collection to explore changes in body composition, body shape satisfaction plus eating and exercise attitudes and behaviours in 36 females students (n = 26 ND and n = 10 OT). The results showed that, despite similar mean body composition measurements at two points of assessment, 64% of ND students either lost or gained > 3% body mass over 12 months of study. Decreases in body mass were associated with decreases in fat, but not in fat free mass. Furthermore, the ND cohort reported an increase in self-esteem and decrease in body shape concern, with 23% (n = 6) of students reporting a reduction in body shape concern. All other mean measurements of eating and exercise attitudes remained stable. However, on the individual level, a decrease in problematic eating and exercise attitudes was noted. These outcomes suggest that in this sample of ND students, progressive learning was associated with positive changes in body composition and body shape satisfaction. Furthermore, intense nutrition- and weight-focused training was not associated with an exacerbation of disordered eating and exercise attitudes.

Overall, this research supported previously expressed concerns about disordered eating attitudes and behaviours in ND students. It also demonstrated that in this sample, symptomatic eating attitudes and high cognitive restraint may be associated with problematic exercise attitudes and behaviours and suboptimal energy status. However, results also suggest that progressive study in nutrition and dietetics may have a positive effect on body- and eating-related issues. These findings are highly relevant for educators and professional bodies concerned with the development of curricula and training programs for this population. These outcomes are also valuable in the development of supportive measures to address the needs of students in training to ensure the continuous high standards and integrity of the ND profession.

**Keywords:** body composition, body shape satisfaction, cognitive restraint, disordered eating, exercise addiction, energy availability, nutrition and dietetics students.
Declaration of originality

The research presented in this thesis is original work undertaken by me. Any previously written or published material is acknowledged and referenced. Contribution by others is clearly stated. The content of this thesis has not been submitted for a higher degree at any other university or institution.

Tetyana Rocks  
Opening chapter
Dedication

This thesis is dedicated to my parents, Vitaliy and Eleonora Shvidchenko and to my children, Masha and Sasha.
Acknowledgements

I would like to express my sincere gratitude to all who have helped me.

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Manuscript prepared for submission


Related published manuscript not included in the body of this thesis

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<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>BM</td>
<td>Body mass</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>BSQ8-D</td>
<td>The Body Shape Questionnaire</td>
</tr>
<tr>
<td>CR</td>
<td>Cognitive restraint</td>
</tr>
<tr>
<td>d</td>
<td>Day</td>
</tr>
<tr>
<td>DAA</td>
<td>Dietitians Association of Australia</td>
</tr>
<tr>
<td>DXA/DEXA</td>
<td>Dual energy X-ray absorptiometry</td>
</tr>
<tr>
<td>DIT</td>
<td>Diet induced thermogenesis</td>
</tr>
<tr>
<td>DQESv2</td>
<td>The Dietary Questionnaire for the Epidemiological Studies Version 2</td>
</tr>
<tr>
<td>EA</td>
<td>Energy availability</td>
</tr>
<tr>
<td>EAI</td>
<td>The Exercise Addiction Inventory</td>
</tr>
<tr>
<td>EAT-26</td>
<td>Eating Attitudes Test-26</td>
</tr>
<tr>
<td>EB</td>
<td>Energy balance</td>
</tr>
<tr>
<td>EDS</td>
<td>Exercise Dependence Scale</td>
</tr>
<tr>
<td>EE</td>
<td>Emotional eating</td>
</tr>
<tr>
<td>EE</td>
<td>Excessive exercise</td>
</tr>
<tr>
<td>EEE</td>
<td>Exercise energy expenditure</td>
</tr>
<tr>
<td>EI</td>
<td>Energy intake</td>
</tr>
<tr>
<td>ER</td>
<td>Energy reporters</td>
</tr>
<tr>
<td>g</td>
<td>Grams</td>
</tr>
<tr>
<td>FFQ</td>
<td>Food frequency questionnaire</td>
</tr>
<tr>
<td>FM</td>
<td>Fat mass</td>
</tr>
<tr>
<td>FFM</td>
<td>Fat free mass</td>
</tr>
<tr>
<td>IPAQ</td>
<td>The International Physical Activity Questionnaire</td>
</tr>
<tr>
<td>kcal</td>
<td>Kilocalorie</td>
</tr>
<tr>
<td>kcal.d⁻¹</td>
<td>Kilocalorie per day</td>
</tr>
<tr>
<td>kcal.kgFFM⁻¹</td>
<td>Kilocalorie per kilogram of fat free mass</td>
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<tr>
<td>kg</td>
<td>Kilogram</td>
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<tr>
<td>kJ</td>
<td>Kilojoule</td>
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<tr>
<td>LM</td>
<td>Lean mass</td>
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m  Meter
MET  Metabolic equivalent of task
ND  Nutrition and Dietetics
ORTO-15  The test for the diagnosis of Orthorexia Nervosa
OT  Occupational Therapy
PA  Physical activity
REE  Resting energy expenditure
RMR  Resting metabolic rate
RSES  Rosenberg self-esteem scale
SPSS  Statistical Package for the Social Sciences
TEE  Total energy expenditure
TFEQ-R18  The Three Factor Eating Questionnaire R-18
UE  Uncontrolled eating
USC  University of the Sunshine Coast
VCO₂  Volume of carbon dioxide
VO₂  Volume of oxygen
w  Week
Definition of key terms

**Cognitive restraint** – a tendency to monitor or restrict food intake in attempt to manage body weight or shape. Operationally defined and measured by the Three Factor Eating Questionnaire.

**Disordered eating** – a wide range of subclinical problematic eating behaviours that could not be diagnosed as a specific eating disorder.

**Eating attitudes** – a broad spectrum of feelings, thoughts, beliefs and ideas an individual has about food and eating.

**Eating disorder** – clinically diagnosed mental disorder characterised by severely disturbed eating behaviours and distorted body image.

**Energy availability** – the amount of energy (in kilojoules) that is available for physiological functions. Operationally defined as the difference between total energy intake and exercise energy expenditure.

**Energy balance** – the equilibrium of energy, the relationship between total energy intake and total energy expenditure.

**Emotional eating** – eating or overeating in the absence of hunger as a response to negative emotions such as anxiety, stress or depressive moods. Operationally defined and measured by the Three Factor Questionnaire.

**Energy intake** – the total number of consumed kilojoules/kilocalories.

**Exercise addiction** – a type of behavioural addiction, characterised by obsessive pre-occupation and obligatory nature of exercise. Operationally defined and measured by the Exercise Addiction Inventory.
Symptoms of eating disorder – at-risk attitudes or behaviours, which may indicate presence of an active eating disorder. Operationally defined and measured by the Eating Attitudes Test – 26.

Total energy expenditure – the total number of expended kilojoules/kilocalories. Operationally defined as the sum of resting metabolic rate, exercise energy expenditure, and diet-induced thermogenesis.

Uncontrolled eating – a tendency for disinhibited overeating and eating without perceived control. Operationally defined and measured by the Three Factor Questionnaire.
Chapter 1: Introduction

Introduction to Chapter 1

This chapter introduces the research by providing a background on the concepts explored in this thesis and explaining the rationale for this project. The chapter lists the aims and objectives investigated by this project, and outlines data collection methods, procedures and the timeline used in this research. It also outlines thesis structure, presentation and organisation.
1.1 Background

Eating attitudes include a vast range of thoughts, feelings, ideas, values, and goals that define the relationship humans have with food.\textsuperscript{1,2} These attitudes are greatly affected by personal beliefs, knowledge, and the environment and, in turn, shape eating preferences and eating behaviours.\textsuperscript{3-5} In modern society, consumption of food has evolved from a mere ingestion of nutrients necessary for survival to an intricate part of life. What and why modern humans eat is often a consequence of dynamic and complex individual and collective processes.\textsuperscript{6} Eating attitudes and behaviours are multifaceted and integrated combinations that both stem from and influence the physiological, psychological and emotional characteristics of an individual.\textsuperscript{2,6-10} For example, what and why a person eats may be due to a desire to change his or her appearance, or a consequence of a new exercise or dieting regimen. Thus, eating attitudes and behaviours are firmly interconnected with dietary practices and intake, body satisfaction and composition, and exercise attitudes and practices (Figure 1).

![Diagram showing the interconnected nature of eating attitudes and behaviours and other physiological, psychological and emotional factors.](image-url)
1.2 Introduction and rationale for this research

1.2.1 The profession of nutrition and dietetics

Dietitians are health professionals with a wide knowledge in nutrition, food science, public health and research. They are the only health professionals who have tertiary qualifications in prevention, treatment and management of nutrition- and diet-related human diseases. Dietitians and nutritionists employ scientific methods and principles to promote, improve and sustain health by providing evidence-based information on food, and by guiding optimal food and nutrition-related behaviours.\textsuperscript{11-13} Those trained as accredited practising dietitians or nutritionists are dedicated to improving the well-being of individuals, groups and populations through provision of nutrition and dietary advice.\textsuperscript{11,12,14} University-trained nutritionists are also educated in nutrition, food science, public health and research. In Australia, the main difference between a dietitian and a nutritionist is that dietitians are trained to give specific advice in medical nutrition therapy, clinical nutrition, and food service management on either individual or group level.\textsuperscript{11,15,16} To become a dietitian, an individual must complete a dietetic program accredited by the Dietitians Association of Australia (DAA), the largest professional body for dietitians and nutritionists in Australia.\textsuperscript{17}

Dynamically growing interest in health and nutrition is reflected in the current growth in nutrition and dietetic (ND) professions in Australia.\textsuperscript{13,14,18} According to DAA, over 5,900 individuals were registered with the organisation in 2016.\textsuperscript{19} Nutrition and dietetics is a young, female-dominated profession. The majority (over 90\%) of individuals employed in the dietetics field in Australia are women under 35 years of age.\textsuperscript{13} Nutritionists and dietitians work in a variety of settings, including: healthcare and social assistance industries (e.g., hospitals, public and private health organisations and companies and age care facilities); the food and sport industry; educational organisations and the private sector. The diversity of services provided by ND professionals ensures the sustainable growth of this profession.\textsuperscript{12,13}

University-based undergraduate ND courses in Australia have also experienced growth. Health Workforce Australia reported that over 450 students completed their studies in dietetic courses in 2012. This included over 230 students that completed bachelor courses
that same year, representing a five-year increase of almost 20%.\textsuperscript{13} Previous research have shown that a large proportion of students who have chosen to study nutrition and dietetics both in Australia and internationally, has indicated an interest in health and nutrition and a desire to help others as two of the main reasons to study these degrees.\textsuperscript{20-23} During their studies, ND students rapidly acquire a substantial knowledge of food, food science, human health, and a variety of other food-, nutrition- and diet-related topics. This relates equally to students studying both nutrition and dietetics or nutrition degrees. Additionally, to successfully graduate, students who have chosen to study an accredited nutrition and dietetics degree in Australia must meet the National Competency Standards for Dietitians in Australia that are endorsed by the DAA. The standards identify 55 competencies related to knowledge, skills and behaviours expected from an entry-level dietitian.\textsuperscript{24} Currently, students completing a nutrition degree in Australia are not required to meet specific professional competencies. However, to register with the Nutrition Society of Australia, a professional organisation that offers a voluntary registration of nutritionists in Australia, nutrition degree graduate is required to possess and maintain a high level of professional knowledge and practice.\textsuperscript{25} Therefore, undergraduates of ND degrees are expected to develop specific profession-required attributes and characteristics during their tertiary training to successfully enter the ND workforce.\textsuperscript{22-26}

1.2.2 Disordered eating attitudes and behaviours in nutrition and dietetics students

Due to the nature of their profession, dietitians and nutritionists are often viewed by the public as being individuals with model eating behaviours and body size.\textsuperscript{20,27} Furthermore, students of ND disciplines and practicing professionals alike have previously expressed feeling obligated to behave and look in a way that matches these perceived expectations firstly, in order to fit into the profession, and then to continue with their career development.\textsuperscript{28-31} However, this increased and continuous study-related focus, followed by professional focus on diet- and weight-related issues may trigger personal pre-existing issues related to food or body image.\textsuperscript{29,32} As such, personal struggles with disordered eating or weight have also been previously reported by nutrition and dietetic students as being motivating factors to joining the ND profession.\textsuperscript{20,32,33}
The topic of disordered eating attitudes and behaviours in ND students has been of interest to researchers for the past several decades. Several studies (that are fully reviewed in Chapter 2) have been published on this issue, with one of the first completed as early as 1985. Then, Crockett and Littrell\textsuperscript{34} conducted a cross-sectional survey to compare eating patterns and dietary behaviours between female students (juniors and seniors) studying three different undergraduate degrees: dietetics, education and social science and humanities in a North American university.\textsuperscript{34} The researchers were motivated by anecdotally high number of individuals applying for dietetic degrees presenting with concerns about their eating behaviours. The study revealed that, paradoxically, despite dietetics students having more positive eating habits when compared to undergraduates enrolled in other degrees, this group also had a greater proportion of individuals (around 20\%) with problematic eating behaviours, such as self-induced vomiting. In their discussion of this finding, the researchers questioned whether such high prevalence of problematic behaviour was because the nutrition field of study attracts individuals with pre-existing disordered habits, or whether dietetic training “promotes”\textsuperscript{34} such behaviour. The latter was explained as a possible consequence of perceived discrepancy between increasing nutrition knowledge (i.e., dietetics students were learning about optimal food intake and balanced diet) and their actual food intake. In addition, it was suggested that a dynamic increase in nutrition knowledge could have also increased tendencies around food restriction and pre-occupation with food and eating.\textsuperscript{34}

Other studies that followed the Crockett and Littrell\textsuperscript{34} investigation reported somewhat contradicting results. Some concluded that students in undergraduate nutrition-focused degrees may have a greater prevalence of eating disorder symptomology and eating psychopathology, such as cognitive restraint, than students studying other degrees.\textsuperscript{35-37} In particular, it was suggested that students who were just starting their studies (i.e., enrolled in first year) were at an increased risk.\textsuperscript{36-38} On the contrary, other studies showed that disordered eating attitudes and behaviours are similar or lower in students studying ND degrees compared to students enrolled in other undergraduate programs.\textsuperscript{39,40} However, due to the majority of investigations conducted to date being cross-sectional in nature, it remains unclear whether studying nutrition and dietetic has any influence on problematic eating attitudes and behaviours.
1.2.3 Implications for nutrition and dietetics professions

Disordered eating attitudes and behaviours of ND students present a serious issue to educators. For example, the results of an international survey of university nutrition and dietetic programs from 14 English speaking countries, including Australia, showed that almost 77% of educators thought that eating disorders were a concern in ND students.\(^{41}\) However, only around 15% of the participants reported that their institution had formal policies and procedures in place to provide help to students. Furthermore, although one-third (37%) thought that having an eating disorder as a student may put the public at risk, over half of respondents (53%) believed it was necessary for the students with eating disorder symptomology to receive help in order to continue their studies. The results also highlighted serious ethical dilemmas, such as prospects of screening potential students for eating disorders before accepting them into an undergraduate nutrition or dietetic program. The authors concluded that although eating disorders seem to be of concern in ND students, more research is needed to develop an approach to best manage this situation.\(^{41}\)

In 2008 Houston and colleagues, on behalf of the American Dietetic Association, called for an open dialogue on the issue in their article “Eating Disorders among Dietetics Students: An Educator’s Dilemma.”\(^{27}\) The authors suggested that, while dietitians and nutritionists may be perceived as unlikely to have any food-related problems, they (as with the rest of the population) may experience a range of eating behaviours, including disordered eating that could result in a range of eating disorders. Furthermore, the group called disordered eating “a reality” in ND professions that should be addressed in the unique environment of an undergraduate setting.\(^{27}\)

In 2015 Houston and associates continued their dialogue in the narrative on ethical issues and considerations that could arise in an instance of an active eating disorder in an undergraduate ND student.\(^{42}\) The authors based their approach on an existing framework to outline specific steps that could help educators and supervisors facing an ethical dilemma of managing such a student. The document stresses that an active eating disorder in a practicing ND professional may have critical ramifications for their practice due to possibly distorted eating and body image attitudes. Therefore, it is crucial to address these
problematic issues during the vocational training to prevent and manage individual and public risks.\textsuperscript{42}

\textbf{1.2.4 Rationale for this research}

Nutrition and dietetic programs facilitate the development of knowledge and skills in relation to food, nutrition, and physique across all years of training. However, currently there is little consistent evidence on the relationship ND students have with food and eating. The interconnected nature of eating attitudes and behaviours is poorly investigated in this population. There is also limited understanding on the influence of ND tertiary training on the eating attitudes and behaviours of students. It is important to consider whether exposure to nutrition and dietetic knowledge, principles, behaviour and culture experienced by the students during their studies results in healthier eating attitudes and behaviours, or alternatively, exacerbates disordered thoughts and practices.

This research significantly broadens our understanding of the relationship between the vocational training of students enrolled in ND programs and eating attitudes and behaviours of this group. It also highlights the associations between these factors and the energy intake, energy balance, exercise attitudes and practices, and body composition of ND students. In doing so, it will raise awareness of the prevalence of maladaptive or disordered eating practices in ND students in Australia and whether there are specific determinants that can be linked to this vocational training pathway. This research will be of interest to university and industry educators, practitioners, and the professional organisations that accredit or endorse university programs in ND.

\textbf{1.2.5 Significance of this research}

This research is the first to investigate eating attitudes and behaviours in ND students within Australia. The research also explores energy and macronutrient intake, energy availability and energy balance in the target population. Additionally, and building on previous knowledge in the area of disordered eating attitudes and behaviours in active individuals, this project examines the influence disordered eating has on energy and macronutrient intake, and energy status amongst ND students. Furthermore, this research is the first to examine the prevalence of exercise addiction and its relationship to disordered and restrained eating in a group of Australian ND undergraduates.
This project also investigates changes in eating attitudes and behaviours throughout a period of vocational training as students’ knowledge of food and nutrition expands. The majority of investigations of eating attitudes and related factors amongst students or graduates of ND programs to date have only investigated these issues at a single point in time (i.e., cross-sectional investigation of students from differing years of vocational training). This research is the first of its kind to explore these concepts both cross-sectionally and longitudinally.

1.2.6 Philosophical approach

The design of this research is based on post-positivist philosophical worldview and uses quantitative methods of data collection. The research is descriptive and non-experimental and includes cross-sectional and follow-up data collection stages as described in Section 1.4.4 of this chapter. The research design is primarily based on previously published methods and includes recognised and validated questionnaires and techniques described in Section 1.4.3 of this chapter. The author was responsible for the collection and analysis of all data for this research.
1.3 Research aim and objectives

This research had three guiding aims and several specific objectives that are outlined below. A schematic summary of the aims, objectives, data collection stages and the main outcomes of this research disseminated to date, are presented in Figure 2.

1.3.1 Research aims

The research aims were the following:

1. To describe eating attitudes and behaviours of students undertaking tertiary training in nutrition and dietetics and nutrition undergraduate degrees.
2. To explore associations between the eating attitudes and behaviours and other psychological and physiological factors in this group.
3. To examine the change in eating attitudes and behaviours of ND students over one year of university study.

1.3.2 Research objectives

Specific objectives were:

1. To examine the eating attitudes and behaviours, cognitive restraint, uncontrolled eating, and emotional eating of ND students.
2. To compare these factors between students enrolled in the first year of their ND studies and the rest of ND cohort.
3. To compare the eating attitudes and behaviours, including the prevalence of eating disorder symptomology, cognitive restraint, uncontrolled eating and emotional eating between ND and another undergraduate cohort (occupational therapy, OT).
4. To explore specific differences between individuals with and without eating disorder symptomology.
5. To estimate the overall energy and macronutrient intake, energy availability and energy balance of the target group.
6. To explore differences in body composition of participants depending on their eating disorder symptomology and cognitive restraint.
7. To explore associations between energy intake, energy availability and energy balance and disordered eating in ND students.
8. To examine the prevalence of exercise addiction in the ND cohort.
9. To estimate the levels of physical activity in the target group.
10. To compare the prevalence of exercise addiction and the levels of physical activity between the ND and the OT cohorts.
11. To explore associations between exercise addiction, levels of physical activity and disordered eating in the target group.
12. To examine individual changes in eating and exercise attitudes and behaviours in ND students over one year of study.
13. To measure changes in body composition of this group.
14. To explore relationships between changes in these measures and changes in other psychological and physiological factors, such as self-esteem, body shape satisfaction and body composition.
<table>
<thead>
<tr>
<th>Research aims</th>
<th>Research objectives</th>
<th>Research outcomes (manuscripts)*</th>
</tr>
</thead>
</table>
| 1. To describe eating attitudes and behaviours of students undertaking tertiary training in nutrition and nutrition and dietetics undergraduate degrees | 1. To examine the eating attitudes and behaviours, cognitive restrain, uncontrolled eating, and emotional eating of ND students.  
2. To compare these factors between students enrolled in the first year of their ND studies and the rest of ND cohort.  
3. To compare these factors between ND and OT students.  
4. To explore specific differences between individuals with and without eating disorder symptomology.  
5. To estimate the overall energy and macronutrient intake, energy availability and balance of the target group.  
6. To explore differences in body composition of participants depending on their eating disorder symptomology and cognitive restraint.  
7. To explore associations between energy intake, energy availability and energy balance and disordered eating in ND students.  
8. To examine the prevalence of exercise addiction in the ND cohort.  
9. To estimate the levels of PA in the target group.  
10. To compare the prevalence of exercise addiction and the levels of PA between the ND and the OT cohorts.  
11. To explore associations between exercise addiction, PA volume and disordered eating in the target group.  
12. To examine individual changes in eating and exercise attitudes and behaviours in ND students over one year of study.  
13. To measure changes in body composition of this group.  
14. To explore relationships between changes in these measures and changes in other psychological and physiological factors, such as self-esteem, body shape satisfaction and body composition. | 1. Eating attitudes and behaviours of students enrolled in undergraduate nutrition and dietetics degrees |
| 2. To explore associations between the eating attitudes and behaviours and other psychological and physiological factors in this group | 2. The relationship between dietary intake and energy availability, eating attitudes and cognitive restraint in students enrolled in undergraduate nutrition degrees |
| 3. To examine the changes in eating attitudes and behaviours of students over one year of university study | 3. Prevalence of exercise addiction symptomology and disordered eating in Australian student studying nutrition and dietetics |

Figure 2. Schematic summary of the aims and objectives, data collection stages, and outcomes.
*Conference presentations are not included. Please refer to Appendices 1 – 4 for abstracts and presentations.
ND – nutrition and dietetics; OT – occupational therapy; PA – physical activity.
1.4 Research methods

1.4.1 Research settings
This study was set in the School of Health and Sport Sciences (SHSS) at the University of the Sunshine Coast (USC). The USC is a relatively new, rapidly growing tertiary institution established in 1996. It is located in South-East Queensland, Australia. The university currently offers two health-oriented, nutrition-focused undergraduate degrees: a professionally accredited 4-year Bachelor of Nutrition and Dietetics degree and a non-accredited 3-year Bachelor of Nutrition degree.

1.4.2 Target and comparison populations
The target population for this research were all USC students enrolled in August 2013 in the Bachelor of Nutrition and Dietetics or Bachelor of Nutrition across all years of study (n = 277 enrolments according to the 2013 census data). While statistical data were unavailable, anecdotally it has been noted that undergraduate students sometimes change their initial enrolment preference and transfer between nutrition and dietetics degree and nutrition degree during their course of the study. Therefore, it was important to collect data from both populations. Additionally, including both nutrition-focused undergraduate degrees increased the pool of participants which strengthen the data. Possible limitations of this approach will be discussed in Chapter 7 of this thesis (page 174). Undergraduate students enrolled in the Bachelor of Occupational Therapy (OT) were used as a comparison group (n = 267 enrolments). The OT is one of the other health-oriented professionally accredited undergraduate degree programs offered by the SHSS at the USC. The OT cohort was chosen for convenience and the health-focused curricula of the OT degree. In addition, this cohort of students has similar characteristics to the ND cohort. These include demographic characteristics such as age and sex ratio. Earlier publications have shown that both ND and OT student populations have a comparable age and age-group distribution.\(^{13,21,43-45}\) Similarly to ND population, approximately 90% of individuals studying an undergraduate OT degree or working in the field are female.\(^{13,21,43,45-48}\) Additionally, previous research has shown that OT students are generally caring and health-conscious individuals who have chosen to study the OT degree due to personal interests in health and well-being.\(^{43,44,48-51}\) There were no specific exclusion criteria for involvement in this study, apart from exclusion of pregnant females.
from body composition assessment by the dual energy X-ray absorptiometry (DXA) described in Section 1.4.3 of this chapter.

### 1.4.3 Data collection methods

This research used several questionnaires and measures for data collection (Table 1). The description of these measures is provided below and in the method sections of Chapters 3-6 where appropriate. Copies of the questionnaires are attached in the Appendices chapter as indicated.

Table 1. Methods of data collection (self-reported (SR) questionnaires/scales and measured (M) parameters) used during data collection in Stage 1 (August-December 2013) and Stage 2 (August-December 2014).

<table>
<thead>
<tr>
<th>Measured characteristic</th>
<th>Tool/Measure</th>
<th>Type</th>
<th>Stage 1</th>
<th>Stage 2</th>
</tr>
</thead>
<tbody>
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<td>Demographic and dietary</td>
<td>Demographic questionnaire</td>
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<td>✓</td>
</tr>
<tr>
<td>Eating attitudes and behaviours</td>
<td>Three-Factor Eating Questionnaire</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>The Eating Attitudes Questionnaire - 26</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>The ORTO-15⁹</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Exercise attitudes and behaviours</td>
<td>Exercise Addiction Inventory</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>International Physical Activity Questionnaire</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>Rosenberg Self-Esteem Scale</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Body shape satisfaction</td>
<td>Body Shape Questionnaire</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Body composition (body mass, height, fat mass, fat free mass)</td>
<td>Self-reported height</td>
<td>SR</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Self-reported current, lowest, highest and ideal body weight</td>
<td>SR</td>
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<td>✓</td>
</tr>
<tr>
<td></td>
<td>Measured body mass</td>
<td>M</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Measured height</td>
<td>M</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Dual energy X-ray absorptiometry</td>
<td>M</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Metabolic requirements</td>
<td>Resting metabolic rate</td>
<td>M</td>
<td>✓</td>
<td>X</td>
</tr>
</tbody>
</table>
Dietary intake
Three 24-hour dietary recalls
The Dietary Questionnaire for Epidemiological Studies
Nutrition knowledge
General Nutrition Knowledge Questionnaire

\textsuperscript{a} Data collected by the ORTO-15 were not used in this project due to sub-optimal psychometric performance (Cronbach’s alpha < 0.4).

\textsuperscript{b} Data collected by the Dietary Questionnaire for the Epidemiological Studies are not presented in the body of this thesis. Please refer to Appendix 5 for an explanation and presentation of the outcomes.

\textsuperscript{c} Data collected by the General Nutrition Knowledge Questionnaire were used in an honours project co-supervised by the author and is not presented in the body of this thesis. Please refer to Appendix 6 for further explanation and presentation of the outcomes.

1.4.3.1 Assessment of the eating attitudes and behaviours

The following validated questionnaires were used to assess eating and exercise attitudes and behaviours:

\textit{The Eating Attitudes Questionnaire} - 26

The Eating Attitudes Test - 26 (EAT-26) is a 26-item questionnaire. The questionnaire has been widely used in assessment of maladaptive eating attitudes and behaviours symptomatic of an eating disorder in both adolescent and adult populations.\textsuperscript{37,52-55} The EAT-26 comprises three parts. Collection of demographic information such as age, gender, height, weight, perceived ideal weight and weight history; a selection of statements questioning attitudes related to eating, dieting and body satisfaction; and behavioural questions related to the six-month period prior to completing the questionnaire.

Parts two and three of the questionnaire assess the participant’s responses on a 6-point Likert-type scale. Part two assesses attitudes using questions such as “I avoid eating when I am hungry” and “I feel extremely guilty after eating.” The answers range from “always” to “never” and contribute to a composite score, ranging from 0 to 78. Scores ≥ 20 are could be associated with abnormal attitudes and behaviours symptomatic of an eating disorder. Part three assesses behaviours with questions such as “In the past six months
have you gone on eating binges where you feel that you may not be able to stop?” Possible answers range from “never” to “once a day or more” and could be used to further explore types and frequencies of diet-related disordered behaviours.

The initial concurrent validity of the tool was established using a sample of young females with and without anorexia nervosa (n = 65 and n = 93 respectively).\textsuperscript{56} Criterion-related validity was recorded in a larger comparison study that also used young female participants with and without the anorexia nervosa diagnosis.\textsuperscript{52} That study also reported a high internal consistency of the tool (Cronbach’s alpha coefficient of 0.90 for the clinical sample).\textsuperscript{52} In the past three decades, the EAT-26 is one of the most often used tools for screening of eating disorder risk and has been used in a broad-age populations with varying backgrounds both internationally and in Australia.\textsuperscript{57} For example, EAT-26 was used in an eating disorder study of Australian (n = 146 men, n = 151 women, age range 17 – 50 years) and Indian university students (n = 125 men, n = 124 women, age range 18 – 36 years);\textsuperscript{58} and more recently in an eating attitudes study of Caucasian Australians (n = 110), Asian Australians (n = 130) and Thai (n =101) female university students.\textsuperscript{59} A copy of the EAT-26 is provided in Appendix 7 of this document.

Three-Factor Eating Questionnaire

The Three-Factor Eating Questionnaire – Revised 18 items (TFEQ-R18)\textsuperscript{60} is a validated shorter version of the Three-Factor Eating Questionnaire,\textsuperscript{61} which was used to measure three psychological dimensions of human eating behaviour: 1) uncontrolled eating (UE), 2) emotional eating (EE), and 3) cognitive restraint (CR) over eating. It includes statements and questions such as “I deliberately take small helpings as a means of controlling my weight” and “How often do you feel hungry?” Answers are based on a 4-point Likert-type scale (range 1 to 4), and summed to calculate a transformed score for each dimension of the eating behaviour (range 0 to 100). The questionnaire does not have a cut-off score with a greater score for each dimension indicating a greater extent of the behaviour. The psychometric properties and factor structure of this version of the questionnaire was initially established in 4377 adult subjects (n = 1774 men and n = 2603 women, age range 37 – 57 years).\textsuperscript{60} Two types of construct validity, convergent and discriminant, were tested for the revised scales. Cronbach’s alphas for the scale were reported as 0.83 (UE), 0.77 (CR), and 0.85 (EE). The TFEQ-R18 have been used in
studies of the general population (a cross-sectional study of eating behaviours in adults (n = 529) and adolescents (n = 358) of both gender;\textsuperscript{62} a longitudinal study of eating behaviours in adults (n = 466) and adolescents (n = 271);\textsuperscript{63} and a cross-sectional study of young females (n = 2997, age range 17 – 20 years).\textsuperscript{64} A copy of the TFEQ-R18 is included in Appendix 8 of this document.

The \textit{ORTO-15}

The test for the diagnosis of orthorexia nervosa (the ORTO-15) is made-up of 15 multiple-choice items and examines preoccupation with food and healthy eating.\textsuperscript{65} It includes questions such as “Do you think that eating healthy food changes your life-style (frequency of eating out, friends, etc.)?” The answers for this tool are based on a 4-point Likert scale (maximum score = 60). The tool was constructed using 404 Italian adults and validated in a sub-sample of 121 adults, including tertiary students. Based on their eating behaviour, participants were subdivided depending on their eating habits and personality traits. Efficacy, sensitivity, specificity predictive validity of the ORTO-15 were established using a proposed cut-off < 40.\textsuperscript{65} The tool has been previously used in several English and non-English speaking populations of young adults.\textsuperscript{65-69} However, the data obtained by the ORTO-15 were not utilised in this project due to sub-optimal psychometric performance (Cronbach’s alpha < 0.42). Please refer to Appendix 9 for further explanation and a copy of the tool.

1.4.3.2 Assessment of the exercise attitudes and behaviours

\textit{Exercise Addiction Inventory}

The Exercise Addiction Inventory (EAI) is a six-point exercise addiction screening inventory.\textsuperscript{70,71} This validated tool examines individual’s beliefs and experiences based on the perceived importance of exercise. The EAI assesses six components of addiction including the following: salience, mood modification, tolerance, withdrawal symptoms, conflict and relapse. Each component has a specific question or statement, such as “Over time I have increased the amount of exercise I do in a day” for the tolerance component. Answers range from “strongly disagree” to “strongly agree” and are allocated scores to reflect an addictive behaviour (range 1 – 6). Final scores (possible range 6 – 36) are obtained by summing all components. The internal reliability, content validity, concurrent validity, and construct validity of this shortened tool has been established in a mixed-sex
group of university students (sport sciences and psychology). The EAI has been used in a diverse range of active populations. Further explanation of the tool, its components and the scoring system is provided in Chapter 5 (page 126). A copy of the tool is included in Appendix 10 of this document.

*International Physical Activity Questionnaire*

Physical activity (PA) level was assessed using the International Physical Activity Questionnaire (IPAQ) – short form. This simple tool consists of seven questions intended to measure all PA in a period of one week. This questionnaire has been validated and is widely used in epidemiological studies. The IPAQ estimates the time spent undertaking four types of activity: vigorous, moderate, walking and sitting for a period of 10 minutes or more. Each type of activity is allocated a specific Metabolic Equivalent of Task (MET) score for each minute spent undertaking this activity. The scores for each activity on each day are then summed and averaged to represent a continuous variable of METs per minute per week. The weekly METs can also be allocated to form three categorical variables of PA: high, moderate and low. Further explanation of this tool is provided in the Methods sections of Chapters 4 and 5 of this thesis (pages 100 and 127 respectively). A copy of the IPAQ is attached in Appendix 11.

**1.4.3.3 Assessment of dietary intake**

Two different methods were used to estimate the dietary intake of the target population:

*Multiple Pass 24-Hour Dietary Recall*

Multiple pass 24-hour recalls were used to collect individual dietary intakes. A total of three 24-hour recalls were taken randomly over a period of several weeks to give an average representation of consumption with two weekdays and one weekend day assessed. Assessment of dietary intake via three to four 24-hour recalls, in person and over the telephone using a standardised approach and measurements, has been used in previous research as a cost-effective and low burden method with an acceptable validity. Further description of this dietary assessment method and the protocol used in this research is provided in the Methods section of Chapter 4 of this thesis (page. 101).
Additionally, the dietary intake of participants was assessed by the Dietary Questionnaire for Epidemiological Studies Version 2 (DQESv2) from Cancer Council Victoria.\textsuperscript{84,85} This questionnaire includes a food list of 74 items with 10 consumption frequency response options that range from “never” to “3 or more times per day”. There are four categories of food items: 1) cereals, sweets and snacks; 2) dairy, meats and fish; 3) fruit; and 4) vegetables. An additional section collects intake of alcoholic beverages. The questionnaire contains 3 photographs of scaled portions for four foods and questions on the overall frequency of consumption. The output provides information on overall energy consumption, as well as consumption of macronutrients, several micronutrient, water and alcohol. Energy intake estimated by the DQESv2 is not reported in the body of this thesis. Please refer to Appendix 5 for further explanation.

1.4.3.4 Measurement of body composition and resting metabolic rate
This research used several methods to estimate body composition. Self-reported measures of height and weight (including lowest, highest and ideal adult weight) were collected by the EAT-26. In addition, height and weight were objectively measured. Height (also referred as “stretch stature” in Chapters 4 and 5 of this thesis) was measured with a stadiometer (Harpenden, Holtain Limited, Crymych, United Kingdom) to the nearest 0.1 cm using an accepted protocol.\textsuperscript{86} Weight (also referred as “body mass” in Chapters 4 – 7 of this thesis) was measured on a calibrated scale to the nearest 0.01 kg (SECA GmbH, Germany). Body Mass Index (BMI) was subsequently calculated based on either self-reported or measured values of height and weight. Highest, lowest and ideal BMI values were calculated based on self-reported highest, lowest and ideal adult weight.

Dual Energy X-ray Absorptiometry
All dual energy X-ray absorptiometry (DXA) scans were undertaken in the whole-body mode on a pencil beam DXA scanner (Lunar DPX, GE Healthcare, Madison, WI) at the USC Health and Sport Centre. The scanning procedures followed a previously described best practice protocol for the assessment of whole body composition.\textsuperscript{87,88} In brief, the scans were conducted between 0500 and 1000. Participants were instructed to present to the laboratory shortly after awakening, fasted and in metal free, minimal clothing. Participants were centrally aligned on the scanner using custom-made positioning aids.\textsuperscript{88} Analyses were performed using GE enCORE v.13.60 software (GE Healthcare) with the
Geelong reference database. The DXA analysis provides information on three compartments of body composition: “fat mass,” “lean mass” and “bone mineral content.” In addition, it provides an opportunity to explore different segments of the body, such as left/right side and upper/lower body with regards to body symmetry. This method of body composition assessment has shown high validity and reliability in diverse populations and is commonly used as a reference method for validation of other body composition tools.88-94

Resting Metabolic Rate
Assessments of resting metabolic rate (RMR) were conducted during Stage 1 of data collection. This assessment was performed at the USC Health and Sport Centre using the Quark RMR metabolimeter.95 The metabolimeter is designed to measure resting energy expenditure (REE) through indirect calorimetry. The unit measures resting energy requirements and identifies metabolism substrate utilization, allowing accurate evaluation of energy requirements. Further description of the RMR assessment and a calculation protocol used in this research is provided in Chapter 4 of this document (page 102).

1.4.3.5 Other tools
Additionally, the following validated tools were used to examine body shape concern, assess global self-esteem, and collect data on socio-demographic and diet-related characteristics.

Body Shape Questionnaire
The 8-item version of the Body Shape Questionnaire (BSQ8-D) was used to assess affective aspects of body dissatisfaction.96,97 This validated scale examines the extent to which concerns about body shape cause distress and interfere with normal activities. Convergent and discriminant validity of the full and shortened versions of the questionnaire were established against a range of demographic, psychological and physical parameters. These included the EAT-26 test in adult women (n = 342, mean age 27.1 ± 8.5 years). The shorter versions of the questionnaire is considered quick, economical and sufficient to explore body image.97,98 The questions on the BSQ8-D explore features of negative body image with questions such as “Have you noticed the shape of other women/men and felt that your own shape compared unfavourably?” and
“Have you worried about other people seeing rolls of fat around your waist or stomach?”

Answers to eight questions are based on a 6-point Likert-type scale, ranging from “never” (1 point) to “always” (6 points). Final answers are summed and assessed as a continuous variable (with higher scores indicating more body dissatisfaction) or further categorised into differing levels of body shape concern (i.e., < 19 – no concern, 19 – 25 – mild concern, 26 – 33 – moderate concern, and > 34 – marked concern with shape). Both, the original and modified forms of the BSQ have been used to assess body shape dissatisfaction in varied populations, including university students of both sexes. Additional description of this tool is provided in Chapter 6 of this thesis (page 152). A copy of the BSQ used in this study is attached in Appendix 12.

Rosenberg Self-esteem Scale
Rosenberg Self-Esteem Scale (RSES) was used to assess self-esteem. This widely accepted 4-point Likert-type scale consists of 10 items, such as “I am able to do things as well as most other people,” which are scored and summed to obtain an overall score. The RSES provides an overall evaluation of one’s perception of their worth or value, with higher scores representative of higher levels of self-esteem. The scale is well-validated and shows good internal consistency, test-retest reliability, convergent and discriminant validity. The RSES was previously used to measure self-esteem in Australian athletes (n = 118 males, n = 116 females, mean age 22.6 years), in university students (n = 6 males, n = 36 females, age range 18 – 24 years), and in individuals with Body Dysmorphic Disorder (n = 27 males, n = 66 females, mean age 32.1 ± 10.5 years) with acceptable internal consistency and sensitivity to change. A copy of the RSES scale is provided in Appendix 13.

Demographic Questionnaire
Relevant socio-demographic and diet-related questions were included in the demographic questionnaire. The questionnaire collected data such as age, gender, marital status and living arrangements. It also explored enrolment program, year level and previous education. Dietary questions included dietary preferences, exclusion of foods and sources of dietary information. This questionnaire was designed and piloted by the author. Ten undergraduate university students (n = 8 females and n = 2 males) participated in the piloting. Minor changes were made to the questionnaire to improve its content validity.
and design layout. These changes included: an addition of two questions to clarify enrolment pattern and three questions to clarify dietary preferences; and changes in the questionnaire layout. During the data collection, two forms of the demographic questionnaire were used. The first form was used in the initial collection of data; whilst a modified version was used in the follow-up data collection. The modifications were made to reflect the follow-up nature of collected data. A copy of the demographic questionnaire is included in Appendix 14.

1.4.4 Data collection procedures and timeline

Timeline of the two stages of data collection are presented in Figures 2 and 3. Stage 1 was initiated in August 2013, during Semester 2 of a general Australian academic year (Figure 2). The timing of this data collection means that the ND students who were starting their undergraduate studies in either nutrition and dietetics or nutrition degrees were yet to have any exposure to nutrition-oriented courses as none of these were offered in Semester 1 2013. Prior to data collection, the author promoted the project to all students enrolled in nutrition and dietetics, nutrition, and OT degrees by attending relevant lectures and tutorials. Additionally, information about the project was placed in relevant sections of the university’s intranet and social media groups. During the promotion, prospective participants received a detailed explanation of the research and its main objectives. The author also described the data collection tools and methods. The aim of the research promotion was twofold: to increase participation rate and to ensure that the research methods were thoroughly explained. The latter aspect and its possible implication on the characteristics of the participants of this research will be discussed in Chapter 7 of this thesis (page 175).

Stage 2 was initiated as a follow-up phase in August 2014 (Figure 3). During this period, all undergraduate students who had already participated in this research in 2013 were invited to repeat assessments. Similarly to the previous year, the invitation to participate was extended through the university’s intranet, social media and in person during relevant classes. The majority of measures that were used in Stage 1 were repeated during Stage 2 as described in Table 1 and illustrated in Figures 4 of this chapter.
Stage 1: August – December 2013

- Online questionnaires
- Body composition
- Resting metabolic rate
- Dietary intake (3 x 24-hour recalls)

August | September | October | November | December

Figure 3. Data collection timeline, Stage 1.
Stage 2: August – December 2014

Online questionnaires

Body composition

Dietary intake (3 x 24-hour recalls)

August | September | October | November | December

Figure 4. Data collection timeline, Stage 2.
1.5 Thesis orientation

This thesis is presented as a series of manuscripts. It includes seven chapters that are organised in the following format:

Chapter 1
This chapter introduced the research by providing a general overview of the topic and explained rationale and significance of this research. The chapter provided the aims and objectives of the project, and included research methodology, methods and the data collection procedures and timeline.

Chapter 2
This chapter describes the key concepts on the topics of disordered eating and exercise attitudes and behaviours. It also explains the links between disordered eating attitudes and dietary intake and energy status. The chapter also evaluates and summarises current knowledge on the prevalence of disordered eating and its correlates in ND student population.

Chapter 3
This chapter consists of the first manuscript published in *Nutrition & Dietetics*, the leading journal of the DAA (impact factor (IF): 0.899). The paper is entitled: “Eating attitudes and behaviours of student enrolled in undergraduate nutrition and dietetics degrees.” The manuscript describes the eating attitudes of the studied population, compares these to the students enrolled in OT degree and explores some of the specific characteristics of the ND individuals with an ED symptomology.

Chapter 4
This chapter includes the second manuscript published in the journal *Appetite* (IF: 3.125). *Appetite* is an international peer-reviewed research journal that specialises on influences and determinants of human food intake. The paper is entitled: “The relationship between dietary intake and energy availability, eating attitudes and cognitive restraint in students enrolled in undergraduate nutrition degrees.” This manuscript outlines energy intake,
availability and balance of the studied group and explores associations between these measures and disordered eating.

**Chapter 5**
This chapter represents the third manuscript entitled: “Prevalence of exercise addiction symptomology and disordered eating in Australian students studying nutrition and dietetics.” This manuscript was published in *Journal of the Academy of Nutrition and Dietetics*. The journal is the principal scientific periodical of the American Academy of Nutrition and Dietetics (IF: 3.609). This paper describes the prevalence of exercise addiction in ND students. It also examines the prevalence of exercise addiction in individuals with eating disorder symptomology and in those with high cognitive restraint.

**Chapter 6**
This chapter includes the fourth manuscript entitled: “Body composition and disordered eating in a sample of Australian nutrition and dietetics students: a 1-year follow-up study.” The paper presents results of the follow-up data collection that shows changes in eating and exercise attitudes and behaviours in the studied cohort. This manuscript will be submitted for publication to *Nutrition & Dietetics*.

**Chapter 7**
The final chapter of this thesis presents an integrative discussion and interpretation of the main findings of this research and outlines its limitations. It also includes recommendations for educational bodies involved in training of ND students and proposes several directions for the future research.

**Appendices**
This thesis also includes a series of appendices that contain abstracts and posters produced to disseminate the outcomes of this research (Appendices 1 – 4). It also presents the article entitled: “Nutrition knowledge of dietetic undergraduate students: An exploratory study,” published in *Nutrition & Dietetics* journal in 2015 (Appendix 6). The paper is a related publication co-authored by the author that investigates nutrition knowledge in the studied cohort. Finally, Appendices 7 – 14 include copies of the questionnaires used by this
research; whilst Appendix 15 presents additional illustration of results not included in the main body of this thesis.

**Presentation and organisation**

The manuscripts presented in Chapters 3 – 6 and in Appendix 6 of this thesis are written as independent documents, therefore some information, such as description of the study sample or methods, is repeated. The manuscripts are formatted according to target journal conventions and differ in presentation and spelling. The Vancouver referencing style is used throughout this thesis. The references cited in each chapter are presented at the end of relevant chapter.
Chapter 2: Background and review of the literature

1.6 References


42. Houston CA, Bassler E, St Germain A. Ethical Considerations When Students Experience an Active Eating Disorder during Their Dietetics Training. J Acad Nutr Diet. 2015;115(10):1715-1717.
Chapter 2: Background and review of the literature


Chapter 2: Review of the literature

Introduction to Chapter 2

This chapter describes the main factors contributing to the concept of eating attitudes and behaviours and disordered eating. It also explains the known links between eating attitudes and behaviours, and physiological, psychological and emotional factors. Finally, this chapter focuses on the current state of knowledge on the prevalence of disordered eating attitudes and behaviours in nutrition and dietetics (ND) students and outlines gaps in the scientific literature on these issues.
2.1 Energy status and disordered eating

In a permissive environment providing an abundance of food choices, selection of daily meals is driven by multiple internal and external cues.\textsuperscript{1,2} Mediators of habitual dietary intake range from fundamental physiological factors such as age, sex, health status and levels of physical activity to convoluted psychological and emotional aspects such as attitudes, moods and feelings.\textsuperscript{1,3-9} For a modern human, principal internal physiological triggers for eating, such as hunger and satiety, may be greatly affected and, at times, overridden by environmental, cultural and social circumstances.\textsuperscript{1,3,10} Furthermore, decisions related to food choice are often dynamic and linked to evolving thoughts and practices that surround this process.\textsuperscript{2} Therefore, in contemporary society, eating, a primary physiological concept of acquiring energy essential for survival, is a complex notion influenced by a vast range of factors.

Energy status is a concept incorporating energy balance and energy availability. Energy balance is equilibrium of energy that could also be viewed as a relationship between total energy intake and total energy expenditure.\textsuperscript{11} It is a dynamic and complex process, homeostasis of which depends on all its components.\textsuperscript{11} Essentially, energy balance is achieved when energy intake (i.e., dietary intake relative to genetics, body composition and physical activity requirements) is equal to energy expenditure (i.e., metabolic requirements and physical activity and exercise energy expenditure)\textsuperscript{11,12} (Figure 1). In healthy weight-stable adults an average energy balance approximates to zero.\textsuperscript{11} Positive energy balance is a consequence of a greater energy intake relative to energy expenditure; whilst a negative energy balance is a result of greater energy expenditure relative to energy intake\textsuperscript{11} (Figure 1). Habitual positive energy balance leads to weight gain, whilst chronic negative energy balance results in weight loss and low energy availability.\textsuperscript{11-14} In the context of disordered eating, negative energy balance and low energy availability may be of concern.
Figure 1. Energy balance, relationship between energy intake and energy expenditure (adapted from Manore et al\textsuperscript{11}).

### 2.2 Disordered eating attitudes and behaviours

Eating attitudes exist on a broad continuum, ranging from normal and flexible thoughts and behavioural patterns to extremely distorted pathological fixations with food and eating\textsuperscript{15} (Figure 2). Although cross-over thresholds between normal and pathological eating attitudes are not necessarily distinct,\textsuperscript{16} commonly a “normal” or healthy pattern of eating includes flexible, mixed and balanced approach to intake of nutrients.\textsuperscript{15} Eating is driven by bodily needs (i.e., hunger) and is associated with pleasurable physiological responses and enjoyable social activities.\textsuperscript{3,17-19} Healthy attitudes and behaviours also include positive body image, body acceptance and flexible approach to exercise.\textsuperscript{20-22}
Disordered eating attitudes resulting in problematic eating behaviours could lead to eating disorders.\textsuperscript{10,15,24-26} Eating disorders are serious mental illnesses which present a great burden to individuals and society.\textsuperscript{10,26-29} Currently, there are several clinically diagnosed eating disorders distinguished by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5).\textsuperscript{30} The manual lists criteria that would determine a specific disorder diagnosis. Five of the distinguished eating disorders include symptomology that is closely dependent on appearance and body shape satisfaction. These are: Anorexia nervosa, Bulimia Nervosa, Binge Eating Disorder, and Other Specified and Other Unspecified eating disorders.\textsuperscript{30} Eating disorders are associated with a range of negative physiological and psychological outcomes. Disordered eating, although appearing less severe than a diagnosed eating disorder, could also lead to numerous adverse consequences. Both clinical eating disorders, and sub-clinical disordered eating have been linked to compromised endocrinological, reproductive, osteological and mental health in both sexes.\textsuperscript{27,31-35}
Disordered eating attitudes may form when complex relationships with food and eating are driven by feelings of stress, negative social comparison, anxiety, guilt and other destructive psychological factors and negative emotions.\textsuperscript{10,15,24,27,36-39} Disordered eating attitudes and behaviours include a number of maladaptive characteristics such as preoccupation with food, exclusion of foods and food groups, meal skipping, dieting and fasting. Food avoidance or dieting may also result in uncontrolled eating that leads to overeating or binging.\textsuperscript{15,40-43} Distorted eating-related cognition may also manifest itself in restrictive and selective eating. An example of disordered eating-related cognition could be the persistent fear of being overweight. Together with negative body image and body weight preoccupation, this could lead to cognitive restraint. Cognitive restraint is characterised by a continuous restriction of food consumption in attempt to reduce or maintain body weight.\textsuperscript{44-46} Furthermore, distorted emotional states, such as anger or anxiety, and mental health issues may cause an individual to seek escape in food, a behaviour also known as emotional eating.\textsuperscript{47-49}

In individuals with disordered eating attitudes, distorted personal views on eating or body size often become one of the most influential factors determining dietary intake.\textsuperscript{1,50,51} For example, individuals with a restrictive type of eating disorder commonly severely limit their food consumption.\textsuperscript{52} Moreover, some studies showed that people with high cognitive restraint may moderate not only the amount, but also the type of consumed food.\textsuperscript{50,53-55} On the contrary, individuals who show high tendency for binge eating or eating in the absence of hunger (due to an emotional state) may regularly overconsume.\textsuperscript{56,57} Thus, over a period of time, different eating attitudes have a great influence on individual's nutritional and energy status.\textsuperscript{1,45}

The epidemiology of disordered eating and eating disorders is complex and multifactorial.\textsuperscript{26} Existing literature identifies three broad determining aspects in a formation of an eating psychopathology: genetics, environmental and societal factors.\textsuperscript{10,26,58} Problematic eating and body image is most prevalent in young females however, the increasing body of evidence shows that these issues are also occur in males and in older individuals of both sexes.\textsuperscript{24,26,59,60} Eating psychopathology can develop in any individual irrespective of ethnicity, education, socio-economic factors, or marital status.\textsuperscript{26,61} Previous population-based studies of adults have estimated a relatively low
life-time prevalence of clinically diagnosed eating disorders (0.5% - 7%).\textsuperscript{29,62,63} However, the prevalence of sub-clinical disordered eating has been estimated at a much greater rate (up to 20% - 30% in some populations).\textsuperscript{60,64-66} Thus, a recent European study conducted amongst adult participants of a weight-management programme estimated that 17% of the sample presented with binge eating. A higher prevalence was reported in females compared to males (20% compared to 8%).\textsuperscript{64} Results of a separate study conducted in French university students (mean age 20.5 years) showed that 26% reported dieting and as many as 22% of the screened group presented with disordered eating symptoms. Similarly to the study in weight-management programme participants, French university females had a greater prevalence of disordered eating compared to males (26% compared to 10%).\textsuperscript{65} Another study conducted in a sample of North American university students aged 18 to 26 years, reported that one-third of participants used disordered compensatory behaviours (e.g., self-induced vomiting or excessive exercise) to manage their body weight or shape.\textsuperscript{66} Results of these and similar studies position eating psychopathology as a real and present issue in the current society.

Eating psychopathology is commonly linked to body size or shape dissatisfaction.\textsuperscript{67} The latter aspect has been named as one of the main origins of the current raise in the prevalence of disordered eating in general population, due to the emphases the modern society and culture places on body image.\textsuperscript{37,68-70} Body shape satisfaction and eating attitudes exist along a same continuum which ranges from healthy body image, body ownership and healthy eating patterns, through body shape preoccupation and disordered eating, to more severe diagnosable clinical disorders\textsuperscript{20} (Figure 2). Body image disturbance is a significant physiological and psychological health issue, which has been found to result in disordered eating, extreme weight management methods, excessive exercise and substance abuse.\textsuperscript{71-74} Moreover, body shape dissatisfaction and negative body image has shown to inhibit preventative health practices such as smoking cessation,\textsuperscript{75,76} cancer prevention screening,\textsuperscript{77,78} and regular exercise.\textsuperscript{79} This is due to a high perceived importance of having an ideal body shape or size for the overall self-esteem, self-acceptance and self-worth.\textsuperscript{20,80}
2.3 Excessive exercise and exercise addiction

The health benefits of exercise are well recognised and offer substantial motivation to maintain a physically active lifestyle. Exercising regularly has shown to improve overall body function, increase work efficiency and decrease the risk of numerous psychological and physical illnesses.\textsuperscript{21,81,82} However, whilst habitual exercise is highly beneficial, loss of control over this activity may lead to problematic or even pathological behaviour.\textsuperscript{21,81,83-85} Morgan first introduced a concept of exercise addition in 1979 and postulated that in some individuals, excessive amount of exercise may interfere with personal and professional life.\textsuperscript{86} More recently, results of several studies have shown that exercise addiction may be present in diverse populations of exercisers from recreational enthusiasts to professional athletes.\textsuperscript{87-97} Previously, two terms have been used to describe this problematic behaviour: “exercise addiction” and “exercise dependency.”\textsuperscript{83} This is due to two conceptually similar validated instruments used in research: the Exercise Dependence Scale\textsuperscript{98} and the Exercise Addiction Inventory.\textsuperscript{99} For the purpose of this review, the term exercise addiction will be used.

Exercise addiction is a type of behavioural addiction which is marked by an obsession with exercise.\textsuperscript{81,83-85,99} The manifestation of this maladaptive behaviour is differentiated into two types: primary and secondary.\textsuperscript{83-85} Primary exercise addiction occurs in the absence of an eating disorder. In a secondary form of addiction, obsessive and excessive exercise co-occur with an eating disorder and with the purpose of altering appearance (e.g., body weight, shape or composition). In primary exercise addiction any appearance-changing activities are undertaken solely to improve performance.\textsuperscript{84,85} In this type, physical activity and exercise become the central entity in life. Individuals with exercise addiction feel a compulsive need to perform obligatory exercise and will continue despite negative health and social consequences, such as mental and physical fatigue, injuries or loss of relationships.\textsuperscript{81,83-85} Similarly with other addictive behaviours, a continuous increase in the amount and intensity of exercise is needed to satisfy the addiction. Individuals with an exercise addiction may also experience withdrawal symptoms and, with time, these withdrawal symptoms become the main motivational feature for continuing to exercise.\textsuperscript{81,84,85} Consequently, exercise addiction is strikingly different from commitment to exercise or desire for a better fitness or athletic performance.
Freimuth and colleagues suggested a four-phase model to explain the distinctive features of exercise addiction.\textsuperscript{85} The model helps to differentiate between dedication to exercise and exercise addiction (Figure 3). It focuses on exercise behaviour as a driving aspect in development of the addiction.\textsuperscript{85} Another model, a biopsychosocial model based on a study of elite Australian athletes, interlinks three major determinants: 1) biological factor; 2) social factors; and 3) psychological factor\textsuperscript{100} (Figure 4). This model suggests that exercise addiction and dependency could originate from dissatisfaction with body weight or shape (in the absence of an eating disorder), and further develops in the presence of social factors (such as perceived pressure from an authoritative figure) and maladaptive exercise beliefs or low self-esteem.\textsuperscript{100} Consequently, the biopsychosocial model extends on the psychological origin of exercise addiction by showing that in some individuals this maladaptive behaviour may stem from body dissatisfaction distinct from that linked to an eating disorder.\textsuperscript{100}

### Phase 1: Recreational exercise
- Exercise are pleasurable and rewarding
- Behaviour is under controlled and is occurring for health/social reasons
- There is no negative consequences

### Phase 2: At-risk exercise
- Mood-modifying effects of exercise are used as a coping mechanism
- Motivation stems from desire to relieve stress or improve self-esteem
- Periodic loss of control

### Phase 3: Problematic exercise
- Exercise is a daily obligation with other activities structured accordingly
- Exercise is performed individually and increases in intensity
- Negative consequences (social isolation, injuries) are occurring

### Phase 4: Exercise addiction
- Exercise are the most important concept in life
- The main motivation for exercise is avoidance of withdrawal symptoms
- Exercise is performed despite negative consequences

Figure 3. The Four-phase model for exercise addiction and dependence (adapted from Egorov & Szabo\textsuperscript{83}).
2.4 Energy availability

Energy availability is a relatively new concept in energy intake assessment. It is defined as energy intake minus exercise energy expenditure (EA = EI – EEE).\(^{12,101}\) Energy availability is presented as amount of kilocalories (kcal) available per kilogram (kg) of fat free mass (FFM) per day (d). For active females, optimal energy availability has been suggested as 45 kcal.kgFFM.\(^{-1}\)d.\(^{-1}\) Range between 45 – 30 kcal.kgFFM.\(^{-1}\)d.\(^{-1}\) has been considered as that leading to weight loss; whilst energy availability < 30 kcal.kgFFM.\(^{-1}\)d.\(^{-1}\) has been proposed as low\(^{12,34,102}\) (Figure 5).

<table>
<thead>
<tr>
<th>&lt; 30</th>
<th>30 – 45</th>
<th>≥ 45</th>
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<tbody>
<tr>
<td>Low</td>
<td>Moderate</td>
<td>Optimal</td>
</tr>
<tr>
<td>Weight loss/ negative health consequences</td>
<td>Weight loss</td>
<td>Weight/muscle maintenance/growth</td>
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</table>

Energy availability (kcal.kgFFM.\(^{-1}\)d.\(^{-1}\))

Figure 4. The Biopsychosocial model of exercise addiction and dependence (adapted from McNamara & McCabe\(^{100}\)).

Figure 5. Energy availability thresholds in active females.
Suboptimal energy status, including negative energy balance and low EA could be the results of several intentional and unintentional behaviours. For example, low EA could occur as a result of a mismatch between dietary energy intake and energy requirements for exercise and physical activity.\textsuperscript{13,103,104} Chronically low energy intake and therefore negative energy balance and low energy availability could be intentional due to efforts to lose or maintain body weight. Deliberate restrictions in energy intake or deliberate increase in energy expenditure is also symptomatic of clinical and subclinical disordered eating.\textsuperscript{30,102} However, low EA may also be inadvertent resulting from a lack of nutrition knowledge and failure to adjust intake to meet growing requirements for age or body size.\textsuperscript{105,106}

The majority of research on the topic of EB and EA to date has been conducted in female collegiate and elite athletes.\textsuperscript{12,102,103,107-111} This is due to the concerning negative consequences a combination of excessive exercise and suboptimal intake may have on health and athletic performance.\textsuperscript{101,102,107,108} Presently, a body of evidence on the issue shows that optimal energy availability is crucial for menstrual and reproductive functions and bone health in active females.\textsuperscript{12,34,101,102,104,106,110-114} The concept of suboptimal energy consumption and its effects in this population is known as the Female Athletes Triad.\textsuperscript{101} The clinical manifestation of the triad includes three main components: low energy availability, compromised bone health and menstrual dysfunction.\textsuperscript{101,102} Energy availability is a pivotal factor in the assessment of energy status as the chronic state of low energy availability has been showing to trigger adverse health consequences.\textsuperscript{101,102} It appears that in athletic population those involved in weight- or appearance-sensitive sports such as gymnastics, aerobics, dancing and running may be at greater risk of inadequate EA.\textsuperscript{33,102,104,107,109,111,115}

Although initial explorations of optimal EA for physiological functions were conducted in female athletic populations, the growing body of evidence shows that low EA could be an issue in recreationally active and sedentary women.\textsuperscript{116,117} Low EA also occurs in active males.\textsuperscript{104,108} However, EA thresholds are yet to be quantified in the latter population due to limited number of studies conducted in males. Nevertheless, some investigations have shown that decrease in EA to < 30 kcal.kgFFM.\textsuperscript{1d,1} either through a restriction in intake or an increase in energy expenditure through exercise, has been associated with
suboptimal nutritional status, reduced metabolism, changes in endocrine profile and compromised bone health.\textsuperscript{13,108,118} Therefore, the concepts of negative EB and low EA are not limited to a specific population of young female athletes as these could be a health risk in other active and sedentary populations.

### 2.5 Eating attitudes and behaviours and relationship to university students

It appears that university students present a particular high risk group for the development of disordered eating attitudes and behaviours. Previous literature has shown that university students commonly have poor eating habits.\textsuperscript{6,8,119-125} Disordered eating and eating disorder symptoms and behaviours are also frequently reported in the university environment.\textsuperscript{68,126-129} For example, in one American study 66\% of female participants demonstrated either “intense” or “at-risk” eating disorder symptoms.\textsuperscript{126} Whilst in a more recent Australian investigation, up to 19\% of female students and 7\% of male students exhibited disordered eating behaviours.\textsuperscript{128} Furthermore, prevalence of disordered and problematic eating behaviours reported across different populations of students, with a diverse cultural backgrounds and disciplines of enrolment.\textsuperscript{42,66,127,129-137}

The high rates of pathological eating behaviours identified in the student population could be due to number of factors.\textsuperscript{42} It is well established that adolescence and early adulthood is the period individuals are most vulnerable to development of maladaptive coping habits, including disordered eating.\textsuperscript{27} Additionally, numerous authors linked the increased levels of perceived stress, including academic stress, with the progress of dysfunctional eating behaviours and eating pathology.\textsuperscript{38,133} Furthermore, specific social aspects of university study such as self-concept formation, frequent engagement in social comparisons and objectification, may lead to increase shape and weight concern and support the development of disordered eating or an increase in its symptomology.\textsuperscript{42,138} Finally, it is well accepted that the modern culture sets unrealistic societal standards of appearance, placing universal pressure on both sexes to conform to the perceived ideal, but often unrealistic, eating behaviours or body shapes.\textsuperscript{10,59,139,140}
2.6 Disordered eating and body shape dissatisfaction in nutrition and dietetics students

Concern with the prevalence of disordered eating behaviour in ND students is not a new phenomenon. Since the study by Crockett and Littrell\textsuperscript{141} (described in Chapter 1), several other research groups have explored eating attitudes and dietary behaviours in nutrition-related tertiary programs.\textsuperscript{142-151} Reinstein and colleagues\textsuperscript{148} compared eating behaviours of female students enrolled in four majors: dietetics, home economics, food science and biological science. This comparison revealed that overall, dietetics students showed healthier food behaviour and attitudes than students of other majors. For example, and similarly to the Crockett and Littrell study,\textsuperscript{141} the score for the “positive eating habits” domain was significantly higher in the dietetics group compared to the rest of the participants. However, when the sample was split according the three different enrolment stages (i.e., freshmen, junior and senior or first, second and third year respectively) the results demonstrated that the dietetics group scored significantly higher in the “negative eating habits” domain than other groups. This domain included preoccupation with food, compulsive eating/bingeing, vomiting after food and eating patterns in opposition to beliefs. Eating behaviours of dietetic students from different years of enrolment also differed. As such, freshmen dietetic students had higher scores on statements related to “controlled by food”, “thinking about food”, and “binging”.\textsuperscript{148} The authors suggested that these differences in outcomes were due to the positive influence of nutrition knowledge.\textsuperscript{148} This study assessed the mean scores of eating attitudes and behaviours, therefore it remains uncertain if the changes were due to the alteration of eating habits and attitudes of particular individuals.

Another earlier study with a cross-sectional design by Fredenberg et al\textsuperscript{149} explored differences in eating attitudes between female students enrolled in dietetics and those enrolled in sports and home economic programs. The results showed that some dietetic students had notably higher tendencies towards disordered eating. Thirty-two precent were always aware of the energy content of food they were eating, 15% were terrified about being overweight, and 12% felt extremely guilty after eating. Furthermore, eating disorder symptomology scores were higher in a proportion of students completing dietetic majors compared to both sports and home economics programs (18% compared to 7%
and 3% respectively). The overall scores suggested no significant difference in the risk of developing eating disorder between the investigated groups.\textsuperscript{149} Therefore, these results did not demonstrate a clear differentiation between the studied cohorts.

The difference between nutrition and non-nutrition students was more apparent in the results of a study by Worobey and Shoenfeld.\textsuperscript{150} Four areas of disordered eating: cognitive symptoms, bingeing and purging behaviour, perceived life-interference of food-related issues, and exercise for weight control were assessed by a self-reported questionnaire developed for the study. Female dietetic students scored the highest in all areas, except exercise for weight control, in comparison to other female health and sport sciences students. Moreover, 53% of dietetics students reported being preoccupied with been overweight most of the time and 23% attempted to control their weight through dietary restriction. Notably, male participants of this study showed no significant preoccupation with eating or body image. However, this group was not subdivided according to their degree and were assessed by comparison to female participants.\textsuperscript{150} Therefore, distinctions could not be made between male and female nutrition students.

Five separate investigations conducted in the last ten years produced inconsistent outcomes.\textsuperscript{144,146,147,151,152} Of these, three studies showed similar prevalence of eating disorder symptomology between nutrition and non-nutrition students.\textsuperscript{144,146,152} All three were conducted in female-only samples and included students across all years of enrolment. The age of participants in these studies was similar (around 18-22 years old) and the prevalence of eating disorder risk was assessed using the Eating Attitudes Test-26 (EAT-26). No differences in eating disorder symptomology between ND and other student groups were seen in these three studies. However, the prevalence of identified individuals at risk of developing an eating disorder differed from around 4%\textsuperscript{146} to just under 20%.\textsuperscript{144,152} These groups did not specify the year of enrolment of the participants, thus the differences in prevalence may well be due to dissimilar proportions of individuals from differing years.

Year of enrolment may play a role. For example, Gonidakis et al\textsuperscript{147} focused on first-year female students to establish the differences in eating attitudes between those enrolled in nutrition degrees and a control group, and to identify possible causes of dissimilarities.
The results showed that the former group had a significantly greater risk for developing an eating disorder (30% compared to 11%, \( P = 0.05 \)). The high-risk group had a significantly more prevalent of individuals living away from families, were significantly more frequently engaged in dieting behaviours and skipping meals, and had higher body dissatisfaction, believing that they were overweight. However, due to the cross-sectional nature of the study the influence of nutritional education and eating and body attitudes were not investigated.\(^{147}\)

Results of another cross-sectional study conducted in mixed-sex sample of students also suggested that year of enrolment may play a role in eating attitudes and behaviours.\(^{151}\) Firstly, the study showed that overall, nutrition students had greater dietary restraint than students from other degrees. However, when the researchers compared nutrition students according to the number of completed semesters, the outcome showed that dietary restraint decreased in those further along in their study. A similar trend of lower restraint in more advanced students was found in non-nutrition participants. However, in the nutrition group, students from higher years of enrolment demonstrated a more balanced approach to eating (i.e., less obsession with food choices). This behaviour remained unchanged in the non-nutrition group.\(^{151}\) The improvement in eating attitudes and behaviours was also supported by a better arbitrary food choice score in more senior nutrition students. The food choice scoring scheme was developed by this study to examine compliance with dietary recommendations. Notably, the study only assessed frequency of consumption of different food groups without measuring the actual dietary intake.\(^{151}\)

Two more recent investigations in the ND student population explored greater spectrum of eating attitudes and behaviours than previous authors.\(^{142,145}\) These studies from South African\(^{145}\) and Portuguese\(^{142}\) research groups included assessments of dietary restraint, and uncontrolled and emotional eating in nutrition undergraduates. The South African research studied an all-female student sample of dietetic (\( n = 24 \) from first-, and \( n = 38 \) from third- and fourth-year of study) and non-dietetic majors (\( n = 83 \), all first-year). The authors reported a trend in a greater prevalence of individuals with eating disorder symptomology in first-year dietetics. Restraint was also greater in first-year dietetics students in comparison to those enrolled in other majors, but not in comparison to
dietetics students from the subsequent years of study. No comparative analysis between non-dietetic freshmen and dietetic seniors was presented, so it is unknown if the differences in cognitive restraint were year- or degree-specific.

The Portuguese study\textsuperscript{142} expanded these results by providing a comparison between year of enrolment (first-, second- and third/forth-year) and degree of enrolment (nutrition and non-nutrition) in a larger, mixed-sex cohort. The outcomes showed that nutrition students of both sexes had a higher level of dietary restraint than those enrolled in other degrees irrespective of their year of enrolment. Here, binge eating was found to be greater in females undertaking nutrition degrees. However, other dimensions of eating (emotional, external or binge) were similar between the groups.\textsuperscript{142} Based on these results, it is challenging to determine if the higher restraint in nutrition students was a result of an increased exposure to food and diet related information. Additionally, greater restraint could have been a result of a greater perceived importance of appearance for the future profession in this group.\textsuperscript{142}

Indeed, it appears that body weight and size is of high perceived importance for ND students. Four studies have focused on these issues. Research by Rasor-Greenhalgh et al\textsuperscript{153} evaluated general body and weight dissatisfaction in a college-based sample to determine any dissimilarities in dietetic and non-dietetic majors. In this study, over 70% of students were dissatisfied with their weight. However, calculations of the group’s Body Mass Index (BMI) suggested that the majority of participants were classified as having a BMI within the normal range (i.e., normal index of body size, based on weight in kilograms being divided by height in meters squared and being between 18.5 and 24.9 kg.m\textsuperscript{-2}).\textsuperscript{153}

Two other studies showed similar results. In research by Kolka and Abayomi,\textsuperscript{154} 90% of participating nutrition students were dissatisfied with their body size (with 83% wishing to be thinner) despite a low mean BMI of 21.8 kg.m\textsuperscript{-2} in this group. The second publication by Arroyo et al\textsuperscript{155} showed that students enrolled in dietetic major were dissatisfied with their body weight. A large proportion (68%) wanted to weigh less. Additionally, almost 11% of the sample have stated an ideal body weight below the normal BMI range of 18.5 kg.m\textsuperscript{-2}, whilst over a third (38%) have stated an ideal
percentage of body fat below the normal range. Interestingly, women who participated in the study had weight in the normal BMI range and only 2% had body fat measurements above the normal range for their age. These results, although common in young individuals, may indicate the needs for support programs for dietitians in training from individual and public health perspective.\textsuperscript{154,155}

Preoccupation with body weight may result in unsafe attempts for lose weight. This was examined in a separate American study on weight-reduction beliefs and behaviours in female dietetics students.\textsuperscript{156} Similarly to the previous studies, the majority of participants (85% of 128 students) had a BMI within the normal range. However, over one third (38%) believed that they were overweight.\textsuperscript{156} Three quarters of the participants also reported that they have attempted to lose weight, with the majority (92%) doing this to improve their appearance, or increase their self-esteem (66%).\textsuperscript{156} When reporting techniques used by participants in attempt to lose weight, researchers grouped them as “sound” and “unsound”.\textsuperscript{156} Most participants used “sound” techniques, such as increasing their physical activity (93%), opting for low-fat dietary options (84%), and using portion control (84%). A number of participants used “unsound” techniques to lose weight, such as skipping meals (56%), fasting (31%), or vomiting after meals (30%). The relatively small sample size of this study (n = 138) precludes from generalising this finding to the whole target population. Nevertheless, it is concerning to find in students striving to become health professionals.\textsuperscript{156}

A smaller Canadian study employed a phenomenological approach to further explore nutrition students’ beliefs and experiences during their years of study.\textsuperscript{157} Study showed an evident identity shift in the participants over time that reflected acquired knowledge. In particular, some students expressed how learning about diet and nutrition helped them to make healthier choices and follow a more balanced diet. However, a “professional” outlook on food and a certain frustration which came with making undesirable choices was also noted. With regards to body size, some students stated that they felt that they must look a certain way to be perceived as a credible dietitian. One particular quote from a student participant provides an honest view on the relationship some ND students may have with their bodies: “You feel like you have to be thin…”\textsuperscript{157} Based on these findings, the authors suggested that educators should use a constructive approach in exploring
students’ differing relationships with food, focusing on the ramifications of these relationships, including body image and body shape dissatisfaction.

2.7 Dietary intake of nutrition and dietetics students

Despite an ongoing interest in eating attitudes and behaviours of ND students, surprisingly little is known about the quantifiable dietary intake in this population. Moreover, the research conducted to date mostly focused on eating habits and eating patterns, such as regularity of meal and snack consumption or consumption of food groups, without quantifying the intake.\textsuperscript{143,147,158} Furthermore, some earlier studies have assessed positive eating habits and drawn conclusions about dietary patterns in this group using only two questions from a diet-related questionnaire (i.e., “I eat well-balanced meals,” and “I have good habits”).\textsuperscript{141,148} Only two published papers have estimated energy and macronutrient intake in the target population. The first paper by an American group of researchers led by Berryman explored the links between attitudes dietetic students have toward obesity, and their dietary intake and body composition.\textsuperscript{159} The intake in this small (n = 38), female-only sample was measured using a validated food frequency questionnaire. The tool allowed quantification of energy, macronutrients, and food groups. Results showed that the majority of participating dietetic students consumed an energy intake within the range recommended for young females of an average height (approximately 2000 to 2800 kcal or 8400 to 11700 kJ per day). The proportion of energy obtained from fat, carbohydrate and protein (31%, 52% and 15% respectively) were also within the recommended ranges. Additionally, the group reported a greater consumption of vegetables and fruit and a lower consumption of fats and sweets than females from a non-dietetic study background. Nevertheless, consumption of fibre was below recommendation in the majority of participating dietetic students with 74% of the sample reporting that they consumed less than the recommended 25 gr per day. No links were found between attitudes toward obesity and dietary intake or body composition. The study did not investigate associations between dietary intake and body composition of individuals, therefore it is not possible to determine if the reported energy or macronutrient intake were adequate for specific individuals within the studied group.
Another study that reported energy intake of Portuguese students studying nutrition-focused degrees similarly used a validated food frequency questionnaire to assess intake. Mean energy intake reported by this sample was approximately 2300 kcal (9600 kJ) per day, whilst proportions of energy intake obtain from the macronutrients were similar to those reported in study by Berryman et al. The Portuguese ND students had a dietary intake containing less fat, juices and soft drinks than students enrolled in other health- and non-health degrees which were used as comparison groups. However, the correlations between dietary intake and eating attitudes was not explored. It would have been interesting to understand this relationship as this sample reported a relatively low eating disorder risk when compared to other studies, with approximately 4% of students of the ND sample displaying eating disorder symptoms. Focusing on specific individuals or comparing dietary intake of participants based on their eating attitudes would have been an advantage to understand if low prevalence of eating disorder symptomology was associated with a particular pattern of dietary intake in this sample.

Two separate studies examined some associations between meal pattern and disordered eating. The first study showed that, as a group, ND students were less likely to skip meals than age-matched comparison groups studying other degrees. However, ND students with eating disorder symptomology were more likely to skip meals compared to those without eating disorder symptoms, irrespective of their degree of enrolment. In contrast, the second study that examined meal regularity in university students showed that although ND students skipped meals less than sport, education or social science students. These behaviours were not associated with disordered eating attitudes. Therefore, it appears that in some ND students disordered eating attitudes were associated with irregular meals, however in others students this association was not established. Furthermore, it remains unclear if skipping meals has actually resulted in compromised nutrition or whether energy intake from skipped meals has been compensated by consumption of increased portions during other times of the day.
2.8 Exercise addiction in student populations

To date, very little is known about the prevalence of exercise addiction in ND students. Only one study published in 2015 has explored this issue as part of an investigation on maladaptive attitudes and behaviours in college students. The study compared exercise addiction eating disorder risk and body weight dissatisfaction between females majoring in exercise science, nutrition and other majors (n = 30, 31 and 28 respectively). The results showed that 16% of nutrition students scored as at risk of exercise addiction, however that proportion was similar to students from other majors (36% and 25% for exercise students and other majors respectively). Furthermore, the study showed a significant positive correlation between exercise addiction and eating disorder risk ($r = 0.62$). Unfortunately, as with the majority of the studies in the ND population, the researchers focused on female students only, therefore the prevalence of exercise addiction in male ND students is currently unknown.

Other authors investigated the issue in students of sport- and exercise-related disciplines. In the first two studies, the prevalence of exercise addiction was explored in mixed-sex samples of British and American sport and exercise science students. Both investigations showed that individuals enrolled in sport related disciplines demonstrated higher tendency to obsessively exercise in comparison to regular exercisers from the general population, and to students enrolled into non-sport related disciplines. In a third study, 257 American university students self-reported the amount of exercise they undertook per week as well as their patterns of exercising. Results indicated that over one fifth of the participants had some form of exercise pathology based on both time per week spent exercising and obligatory nature of this exercise. Notably, the lack of data on eating behaviours in the sample restricts more complete interpretation of the results.

Grandi and colleagues explored the issue of exercise in relation to eating behaviours in a smaller mixed-sex sample of regular exercisers (n = 79, 57% females and 43% males). The study assessed several characteristics, including exercise attitudes, disordered eating, personality dimensions, self-attitude and a state of psychological distress. The researchers aimed to differentiate between primary and secondary exercise addiction. The results
showed that over one third (36%) of participants had exercise addiction, and in almost 30% of sample the exercise addiction was identified as primary. Interestingly, those with primary exercise addiction demonstrated more disorderly eating patterns than those without exercise dependence. This result supports the previously discussed “biopsychosocial” model of exercise dependency by showing that in some cases individuals with primary exercise addiction may present with a greater risk of disordered eating than those without exercise addiction. Additionally, females in that study showed significantly greater dependence on exercise for weight management than males. Females also exhibited significantly greater weight and diet concerns, body dissatisfaction, drive for thinness and disordered eating patterns. However, no gender differences were identified in personality characteristics. Similarly, no self-attitude and mood differences were found between female and male participants however, individuals addicted to exercise were more preoccupied with body shape than those who were non-dependent. The former group also showed greater psychological distress, suggesting that exercise addiction could be considered as clinical pathology.

Similar correlation between exercise addiction, disordered eating and preoccupation with food in women was demonstrated in a larger sample of college undergraduates (n = 237). In this study, female participants scored only slightly higher on the Exercise Dependence Questionnaire. However, on subscales of exercise for weight control women reported significantly higher scores than men. Furthermore, women showed significantly higher association between dieting and food preoccupation, as well as exercise for weight control ($r = 0.62$ and $r = 0.54$ respectively). Additionally, the scores in a subscale measure of exercise for health reasons were also significantly higher in women than in men, suggesting a perceived belief in the relationship between lower body weight and health. Notably, weight and height of the participants were not measured in that study. Consequently, the link between disordered eating, exercise attitudes, excessive exercising and actual weight was not clearly established in that investigation.
2.9 Changes in eating attitudes and behaviours

Currently, it remains unclear whether eating attitudes and behaviours of ND students change over the years of tertiary education. Few studies have investigated the change in eating attitudes and behaviours in sub-clinical populations, such as university students of non-nutrition related degrees.\textsuperscript{163-166} One particular study\textsuperscript{163} examining this issue collected data on frequency of dieting and disordered eating in a large mixed-sex sample ($n = 962$) of college students at the beginning and at the end of their first year of study. The study found no changes in eating behaviours of the majority of participants. However, in the group with reported changes, an increase in disordered eating behaviours was more prevalent than a decrease. Thus, it was significantly more likely for both female and male non-dieters to report dieting at the end of the year compared to the beginning of the year. Similarly, a significant increase in eating disorder symptomology of female participants was noted over the study year.\textsuperscript{163}

In contrast, results of another investigation\textsuperscript{164} showed significant decrease in bulimic attitudes and no significant changes in body dissatisfaction over that time.\textsuperscript{164} This study examined eating disorder attitudes and behaviours in female freshmen during the first 34 weeks of college. An overall decrease in three risk factors (depression, anxiety, and fear of been negatively evaluated by others) was reported in the majority of participants. The study also revealed a significant positive association between restrictive eating attitudes, body dissatisfaction and a fear of negative evaluation by close and distant social circles. Similarly to this study, results of a prospective investigation by Delinsky and Wilson showed an association between dietary restraint and shape or body concern. However, unlike in the 34 weeks study, participants in the study by Delinsky and Wilson demonstrated a significant increase of eating disorder symptoms during the first year of study.\textsuperscript{165}

Finally, a three-year assessment of eating pathology in a separate group of female university students showed no significant changes in eating attitudes over time. In this study, stable scores were achieved for both dietary restraint and eating disorder symptomology at two time points.\textsuperscript{166} Interestingly, these measures remained stable although mean body weight of the group increased over the three years of assessment.
Any changes in dietary restraint were significantly correlated to body and figure dissatisfaction, whereas eating disorder symptomology was correlated to figure dissatisfaction, self-consciousness, and measures of self-worth. Results of this study, one of the longest conducted on the same university sample, support previously established associations between eating psychopathology, body dissatisfaction, and self-esteem. Overall, the reviewed longitudinal studies provide some valuable information on the dynamics of eating and body attitudes during tertiary training. The results of these investigations, when conducted in non-nutrition populations showed no consistency, with some findings suggesting an increase and others a decrease or no change in eating attitudes and behaviours over time.

2.10 Conclusion

Eating attitudes and behaviours range from a healthy outlook on eating and body to severely distorted clinical pathology of eating disorders. Thoughts and actions related to what, how and why humans eat are complex and multifaceted and are determinative of nutritional status and overall health of an individual. Eating attitudes and behaviours are linked to range of other physiological and psychological factors including body satisfaction and exercise attitudes. Consequently, studies of these complex concepts should include integrational approach.

This critique of the literature revealed that the previous research on eating attitudes and behaviours in ND students provided mixed results. Some of the reviewed studies showed a tendency for a greater prevalence of disordered eating in this population, particularly in students enrolled in their first year of tertiary training, than in students studying other health and non-health degrees. In contrast, other investigations showed no differences in the proportion of individuals with eating disorder symptomology between ND and other undergraduate students. It appeared that some studies explored the influence the nutrition education had on eating attitudes and behaving. However, the majority of investigations were cross-sectional and compared group scores between students enrolled in different years of study. Therefore, it is challenging to draw a specific conclusion on the link between nutrition knowledge or dietetic training, and changes in eating attitudes and behaviours on an individual level.
A limited number of studies have explored the actual dietary intake of ND students. Furthermore, these investigations mostly described self-reported eating patterns without determining nutritional adequacy of the diet. None of the previous investigations established whether particular eating attitudes had an influence on the actual dietary intake and nutritional status of the population. It is important to understand the links between these concepts to further build the existing understanding between theoretical concepts of eating attitudes and knowledge, and practical application, to energy intake or energy status.

Another clear gap in the current knowledge is the topic of exercise addiction or dependency in ND students. Yet, the subject of physical activity and exercise is an imperative part of individual and public health that is closely linked to eating attitudes and behaviours. Therefore, developing our understanding of the role exercise plays in psychological and physiological health of ND students is essential.

Additionally, although several studies have investigated body weight, shape and satisfaction in ND students, the majority of conclusions were drawn from self-reported data. It is well established that self-reported measures of sensitive topics, such as weight and shape, may introduce some bias that should be considered in the interpretation of the results. It would be interesting to continue exploring this important issue using objective measures of body composition, for example measured body mass or percentage of fat tissue. Moreover, it would be interesting to explore whether progressive knowledge in health and nutrition has any influence on body composition or satisfaction of ND students.

In conclusion, the reviewed publications highlighted the importance of further investigation of eating attitudes and behaviours in ND students and the association to psychological and physiological characteristics. It is well documented that early intervention with individuals who have issues around disordered eating can ensure a far shorter recovery time than if the intervention occurs once the behaviours are more entrenched.\textsuperscript{167,168} This review demonstrates that although several studies have investigated issues of eating attitudes and body satisfaction in ND students, some areas of research are inconclusive. Furthermore, no cross-sectional or longitudinal research has explored this issue using a full spectrum of methods that combine three interlinking areas:
psychological, physiological and behavioural measures. Exploring these links will provide a better understanding and facilitate development of management and intervention strategies focused on the needs of this population.
2.11 References


Chapter 2: Background and review of the literature


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Chapter 3: Eating attitudes and behaviours of students enrolled in undergraduate nutrition and dietetics degree

Introduction to Chapter 3

This chapter presents results from the first phase of analysis from Stage 1 of data collection of this research. The chapter consists of a paper published in the journal *Nutrition & Dietetics* (please see full reference on the next page) that examines the eating attitudes and behaviours of students enrolled in undergraduate nutrition and dietetics degrees in an Australian university and explores possible relationships between eating attitudes and behaviours and socio-demographic and diet-related characteristics of the group. This paper also compares this group to a group of students enrolled in another health-related degree, occupational therapy. To the author’s knowledge this paper presents the first investigation of eating attitudes and behaviours in an Australian cohort of nutrition and dietetics students. It also provides possible explanation on the phenomenon of disordered eating in this population and suggest some strategies to prevent and ethically manage disordered eating in students studying nutrition-focused degrees.
Full publication reference

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Authors declaration

Tetyana Rocks was responsible for study design, literature search and summary, data collection, analysis and interpretation, and manuscript drafting and editing.

Associate Professor Fiona Pelly was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Gary Slater was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Lisa Martin was responsible for study design, data analysis and interpretation, and manuscript editing.
Eating attitudes and behaviours of students enrolled in undergraduate nutrition and dietetics degrees

3.1 Abstract

Aim: The prevalence of disordered eating has been frequently reported in university students, however the prevalence amongst Australian undergraduate students studying degrees with a focus on nutrition is uncertain. The aims of this study were to: 1) assess eating attitudes and behaviours of students enrolled in nutrition and dietetics, 2) compare to students enrolled in another health degree of occupational therapy, and 3) to explore possible relationships between eating attitudes and behaviours, and other characteristics of both cohorts.

Methods: This cross-sectional observational study investigated self-reported anthropometric characteristics, eating attitudes and behaviours, and self-esteem using a series of questionnaires.

Results: Participants included 137 students (119 females, 18 males) with a mean age of 27.1 ± 8.7 years. Fourteen percent of nutrition and dietetics, and 11% of occupational therapy students had disordered eating attitudes scores that were symptomatic of an eating disorder. Mean eating attitudes scores did not differ between the degrees of study. Students in nutrition and dietetics showed significantly higher levels of cognitive restraint and less emotional eating than occupational therapy students. Enrolment in the first year of study was the strongest predictor of symptomatic eating attitudes.

Conclusions: These findings support previously expressed concern about presence of disordered eating in nutrition and dietetics undergraduates. Collaboratively developed support mechanisms for preventing and managing disordered relationships with food would be of benefit to students enrolled in nutrition degrees to ensure ongoing professional integrity.

Key Words: disordered eating, Eating Attitudes Test, eating behaviours, eating disorders, nutrition and dietetics students, Three-Factor Eating Questionnaire
Chapter 3: Eating attitudes and behaviours of students

3.2 Introduction

Eating attitudes comprise of thoughts, beliefs and behaviours that shape the relationship an individual has with food.\(^1\) Disordered eating attitudes are identified as a wide range of eating irregularities that include preoccupation with food and dieting, dietary restrictions, plus unhealthy and obsessive methods of weight control.\(^1\) These dysfunctional relationships may also manifest themselves in bingeing behaviours, uncontrolled eating (UE) or eating under the influence of stress or emotions. Although disordered eating attitudes and behaviours do not necessarily warrant a specific diagnosis, they could have a significant impact on mental and physical health.\(^1\)

Dietitians and nutritionists work closely with food, and the influence it has on health of individuals and populations. It has been suggested that a professional with disordered eating attitudes or an active eating disorder (ED) may bring their personal views on health and diet into nutritional care, thus compromising evidence-base practice and, potentially, the health of the individual in their care.\(^2\) A European study investigating eating behaviour in dietitians showed that approximately 8% of the sample was considered to be at risk for developing an ED, while 14% had pre-existing issues with eating or weight that motivated them to study nutrition.\(^3\) This has also been demonstrated in an Australian study that showed that 30% of applicants to a nutrition and dietetics program reported personal experiences with obesity or ED as a motivator for enrolling.\(^4\) This phenomenon is not isolated to dietitians. A total of 27% of health professionals working with patients with ED reported previously having an ED.\(^5\) In contrast to the potential negative impacts of compromised practice, overcoming an ED has been suggested to be a positive influence on professional practice for those working in this field.\(^6\) However, there is little evidence whether learning about food and nutrition as part of professional training has a direct influence on disordered eating attitudes.

Previous studies on this population have had mixed results, with some showing a higher prevalence of disordered eating in nutrition and dietetics students than those enrolled in other undergraduate degrees.\(^7\) Other studies\(^8,^9\) have found no difference in eating behaviours when compared with students from other health and non-health related degrees. Nevertheless, the suggestion that students undertaking nutrition degrees may be
at higher risk of disordered eating presents a real ethical dilemma for educators and professional bodies.\textsuperscript{10,11} Therefore, the primary aim of this study was to assess the eating attitudes and behaviours of students enrolled in undergraduate professionally accredited nutrition and dietetics, and non-accredited nutrition degrees in an Australian university. A secondary aim was to compare this cohort to an accredited occupational therapy (OT) degree to determine similarities and differences. The final aim was to explore possible associations between eating attitudes and behaviours and socio-demographic and diet-related characteristics of these cohorts.

3.3 Methods

The study population consisted of undergraduate students enrolled in a three-year non-accredited nutrition degree, and a four-year professionally accredited nutrition and dietetics degree (referred to as the ND cohort), in comparison to a four-year professionally accredited OT degree in Australian university. Participants were recruited through in-class presentations, inter-discipline emails and announcements.

A total of four questionnaires were administered. The Eating Attitudes Test (EAT-26)\textsuperscript{12} was used to identify issues related to eating attitudes and included questions on weight, height, weight history and a perceived ideal weight, and six eating behaviour questions. This tool has been previously validated and widely used to investigate disordered eating and ED symptoms.\textsuperscript{12-15} The questionnaire is not a diagnostic tool but is useful in identifying individuals with abnormal eating attitudes and behaviours. The second questionnaire was the Three-Factor Eating Questionnaire Revised 18 item version (TFEQ-R18),\textsuperscript{16} which assessed food-related psychological and behavioural relationships in three distinct domains: UE (9 items), cognitive restraint (CR, 6 items) and emotional eating (EE, 3 items). The TFEQ-R18 has previously demonstrated good reliability in measuring eating behaviours of young and middle age adult.\textsuperscript{17,18} Similarly to a previous publication,\textsuperscript{17} one item related to UE in the TFEQ-R18\textsuperscript{16} was modified from “When I smell a sizzling steak or a juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal”, into “When I smell a delicious food, I find it very difficult to keep from eating, even if I have just finished a meal”. The modification was due to anticipated participation of individuals who may not consume meat in this study.
The third was the Rosenberg Self-Esteem Scale (RSES),\textsuperscript{19} which measured global self-esteem. The RSES is a validated tool that is commonly used to assess self-esteem.\textsuperscript{13} In our sample, the Cronbach’s alphas coefficients were 0.86 and 0.88 for the EAT-26 and the RSES respectively, and 0.88, 0.71 and 0.87 for the UE, CR, and EE scales of the TFEQ-R18 respectively. Socio-demographic and diet-related information was collected by a previously described questionnaire.\textsuperscript{20} This questionnaire was specifically designed and piloted for the present project and included questions about age, gender, education, marital status, living situation, and dietary behaviours (following a dietary regimen and type of diet). All questionnaires were completed on-line from August through to October 2013 in Semester 2 of a general university year. The study was approved by the University of the Sunshine Coast Human Research Ethics Committee (HREC S/13/525).

All data from psychometric tools were analysed according to methods previously reported in the literature. Total scores on the EAT-26\textsuperscript{12} were derived as a sum of the composite items, with scores ≥ 20 in this study were identified as being reflective of those with disordered eating attitudes symptomatic of an ED. The TFEQ-R18\textsuperscript{16} items were coded on a 4-point response scale, summed to attain the individual scores for each domain and then transformed to a 0 - 100 scale with higher final scores corresponding to dysfunctional relationships with food. The RSES consisted of a 10 statements (e.g. “I take a positive attitude toward myself”) that were answered on a 4-point scale ranging from “strongly agree” to “strongly disagree,” and were summed with higher final scores demonstrating more positive self-esteem.

Body Mass Index (BMI) was calculated based on self-reported height and weight (weight [kg]/height [m\textsuperscript{2}]); whereas the perceived ideal BMI was calculated based on self-reported height and weight, which participants reported as their ideal weight. BMI was categorised according to the World Health Organisation,\textsuperscript{21} with a BMI < 18.5 kg/m\textsuperscript{2} classified as underweight; a BMI of 18.5 – 24.9 kg/m\textsuperscript{2} as normal range; and a BMI ≥ 25.0 kg/m\textsuperscript{2} as overweight or obese.

Statistical analysis was performed using the Statistical Package for the Social Sciences (Version 22.0, SPSS Inc., Chicago, IL, USA). All continuous data were tested for normality. An independent t-test was used to compare age and global self-esteem; Mann-
Whitney U test and Wilcoxon signed rank test was used to compare other continuous data (i.e., BMI, EAT-26 and TFEQ-R18 scores). Chi-square statistics were used to test categorical data (i.e., BMI categories, marital status, dependent children, living situation, and the assessed eating behaviours), with continuity correction and Fisher’s exact test utilised where appropriate. A direct logistic regression was performed to explore predictors of symptomatic eating attitude (scores ≥ 20 on EAT-26). Results were expressed as mean value ± standard deviation or median value and interquartile range (IQR) where appropriate. The differences were considered significant for \( P < 0.05 \).

### 3.4 Results

A total of 137 (66%, \( n = 91 \) ND; 34%, \( n = 46 \) OT) students participated, with the majority female (82%, \( n = 75 \) ND; 96%, \( n = 44 \) OT). There was no significant difference in gender with \( n = 16 \) (18%) ND and \( n = 2 \) (4%) OT males \( (\chi^2 = 3.6, P = 0.058) \). The proportion of ND and OT students enrolled in the first year of study was significantly different with 36% (\( n = 33 \)) and 15% (\( n = 7 \)) respectively \( (\chi^2 = 5.6, P = 0.018) \). Demographic and anthropometric characteristics did not significantly differ across the years of enrolment of either cohort, nor between cohorts. Both cohorts reported lower perceived ideal BMI (Table 1) with 78% \( (n = 9 \) males; \( n = 98 \) females) wishing to weigh less than their current weight. Only 9% \( (n = 6 \) males; \( n = 6 \) females) wished to weigh more, with the remaining 13% \( (n = 3 \) males, \( n = 18 \) females) wishing to weigh the same. There were no differences in weight-related characteristics between ND and OT cohorts. The majority of participants were single (64%, \( n = 87 \)), and lived with a family (61%, \( n = 83 \)), with only 19% \( (n = 26) \) having dependent children.

Both CR and EE differed between cohorts with ND scoring significantly higher \( (P = 0.028) \) for CR \( (44.4, \text{IQR} = 16.7) \) and lower \( (P = 0.028) \) for EE \( (33.3, \text{IQR} = 33.3) \) than OT \( (41.7, \text{IQR} = 18.1 \) and 50.0, \( \text{IQR} = 33.3 \) \) respectively. There was no significant difference \( (P = 0.13) \) in EAT-26 scores for ND \( (8.0, \text{IQR} = 9.0) \) and OT \( (5.5, \text{IQR} = 12.0) \). Similarly, scores for UE did not significantly vary \( (P = 0.10) \) between the cohorts \( (\text{ND 40.7, IQR = 25.9, OT 48.1, IQR = 19.4}) \). All scores measured by EAT-26 and TFEQ-R18 were similar across the years of study for both cohorts. Comparative analysis by gender was not performed due to the low number of male volunteers. The mean self-esteem
scores did not differ across the years of enrolment in ND or OT. Furthermore, the mean scores for ND (19.5 ± 4.9) were not significantly different to OT (19.0 ± 3.4, \( t_{135} = 0.6, P = 0.53 \)).

Eating behaviours were similar within the ND and OT cohorts, apart from following a dietary regimen, with 61% (n = 20) of first year ND students followed a dietary regimen compared to 29% (n = 17) of students enrolled in the second, third and fourth year of their ND studies (\( \chi^2 = 7.3, P = 0.007 \)). For the majority of these (70%, n = 26) the diet was self-prescribed. Fifty two percent, (n = 47) avoided specific foods and food groups, such as highly processed foods, and foods with wheat, gluten or dairy. Over half (56%, n = 51) stated that they exercised for at least 60 minutes per day to lose or control their weight, with a third (33%, n = 17) reporting this activity occurred at least a few times per week. Nearly half (46%, n = 42) experienced uncontrollable eating binges, with a small proportion of these (7%, n = 3) reporting bingeing once a week over the last 6 months. Use of laxatives, dieting pills or diuretics (15%, n = 14), or vomiting after meals (11%, n = 10), was also reported by some individuals from the ND cohort, but for the majority (93% and 90% respectively) these behaviours were restricted to once a month or less. There was no significant difference in eating behaviours between the ND and OT cohort.

A total of 18 individuals (ND: n = 13, 14%; OT: n = 5, 11%) scored ≥ 20 on the EAT-26 test and thus could be classified as having disordered eating attitudes symptomatic of an ED. Degree of enrolment and gender was not associated with the EAT-26 scores (Table 2). Within the ND cohort high scores were not related to year of study with 24% (n = 8) of participating first year students scored ≥ 20 compared to 9% (n = 5) of students enrolled in subsequent years of study. Similarly within the OT cohort, only one student scored ≥ 20 compared to four students enrolled in subsequent years of study. Within the ND cohort, symptomatic individuals scored significantly higher on all three TFEQ-R18 scales than the rest of the participants (\( P < 0.01 \)). Additionally, symptomatic group more frequently engaged in disordered behaviours (Table 2). In contrast, the mean global self-esteem scores were significantly lower in those with high EAT-26 scores compared to the rest of participants (15.4 ± 4.8 compared to 20.2 ± 4.6, \( t_{89} = 3.4, P = 0.001 \)).
Table 1. Comparison of age and body mass index (BMI) characteristics of undergraduate students enrolled in the ND and OT cohorts. Data are presented as mean (SD) unless otherwise specified.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
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<th>OT</th>
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<td>(n = 91)</td>
<td>(n = 46)</td>
<td>(n = 18)</td>
<td>(n = 119)</td>
</tr>
<tr>
<td>Age (years)(^a)</td>
<td>27.1 (8.7)</td>
<td>27.7 (8.6)</td>
<td>26.0 (8.9)</td>
<td>26.9 (5.6)</td>
<td>27.2 (9.1)</td>
</tr>
<tr>
<td>BMI (kg/m(^2), median (IQR))</td>
<td>22.5 (4.3)</td>
<td>22.4 (4.6)</td>
<td>22.3 (4.1)</td>
<td>24.8 (4.6)</td>
<td>22.05 (3.9)*</td>
</tr>
<tr>
<td>BMI categories, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>10 (7)</td>
<td>9 (10)</td>
<td>1 (2)</td>
<td>-</td>
<td>10 (8)</td>
</tr>
<tr>
<td>Normal range</td>
<td>96 (70)</td>
<td>61 (67)</td>
<td>35 (76)</td>
<td>10 (56)</td>
<td>86 (72)</td>
</tr>
<tr>
<td>Overweight/obese</td>
<td>31 (23)</td>
<td>21 (23)</td>
<td>10 (22)</td>
<td>8 (44)</td>
<td>23 (19)</td>
</tr>
<tr>
<td>Perceived ideal BMI</td>
<td>21.2 (2.9)**</td>
<td>20.9 (3.2)**</td>
<td>21.2 (2.7)**</td>
<td>24.5 (4.8)</td>
<td>20.7 (2.7)**</td>
</tr>
</tbody>
</table>

ND – 3-year nutrition degree and 4-year nutrition and dietetics degree; OT – 4-year occupational therapy degree; BMI categories allocated according to WHO: BMI < 18.5 kg/m\(^2\) - underweight; BMI 18.5 – 24.9 kg/m\(^2\) - normal range; BMI ≥ 25.0 kg/m\(^2\) – overweight/obese; \(^a\) – independent t-test t\(_{135}=1.1\), \(P = 0.27\) between ND and OT cohorts, and t\(_{33}=1.1\), \(P = 0.86\) between males and females; \(*\) – \(P = 0.001\) Mann-Whitney U test for males and females; ** – \(P < 0.001\) Wilcoxon signed rank test for total, ND and OT cohorts and female gender between BMI and perceived ideal BMI.
Direct logistic regression analysis was completed to predict symptomatic eating attitudes in the ND cohort. Six independent factors that correlated to the dependent variable of EAT-26 ≥ 20 were used as predictors: age, year of enrolment, global self-esteem, UE, CR, and EE. The full-model test was statistically reliable, $\chi^2(6) = 42.2$, $P < 0.001$, and explained between 37.1% (Cox and Shell $R^2$) and 66.3% (Nagelkerke’s $R^2$) of the variance and correctly classified 93.4% of cases. While year of enrolment, UE and CR made a significant contribution to symptomatic eating attitudes, the strongest predictor of scoring ≥ 20 on the EAT-26 was enrolment in the first year of ND studies (odds ratio of 11.5). This indicates that participants who were enrolled in the first year were over eleven times more likely to score as symptomatic for an ED than those who were enrolled in the subsequent years, controlling for all other factors used in the model (Table 3).

Table 2. Selected characteristics of undergraduate nutrition and dietetics students that scored ≥ 20 and < 20 on the EAT-26.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Scored EAT-26 ≥ 20</th>
<th>Scored EAT-26 &lt; 20</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 13)</td>
<td>(n = 78)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>23.2 (3.7)</td>
<td>28.5 (8.9)</td>
<td>0.001(^a)</td>
</tr>
<tr>
<td>BMI (kg/m(^2), median (IQR)</td>
<td>22.7 (6.6)</td>
<td>22.4 (4.6)</td>
<td>0.40(^b)</td>
</tr>
<tr>
<td>Perceived ideal BMI (kg/m(^2), median (IQR)</td>
<td>20.1 (3.6)</td>
<td>21.2 (3.3)</td>
<td>0.67(^b)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>12 (92)</td>
<td>63 (84)</td>
<td>- (0.45)(^c)</td>
</tr>
<tr>
<td>Male</td>
<td>1 (8)</td>
<td>15 (16)</td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>11 (85)</td>
<td>44 (56)</td>
<td>2.6 (0.11)(^d)</td>
</tr>
<tr>
<td>Married/de facto</td>
<td>2 (15)</td>
<td>34 (44)</td>
<td></td>
</tr>
<tr>
<td>Dependent children</td>
<td>0 (0)</td>
<td>19 (24)</td>
<td>- (0.06)(^c)</td>
</tr>
<tr>
<td>Living situation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>2 (15)</td>
<td>7 (9)</td>
<td>- (0.61)(^c)</td>
</tr>
<tr>
<td>Family/shared accommodation</td>
<td>11 (85)</td>
<td>71 (91)</td>
<td></td>
</tr>
</tbody>
</table>
Eating behaviours

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>B (95% CI)</th>
<th>Odds ratio (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Followed dietary regimen</td>
<td>0.11 (0.00 – 1.09)</td>
<td>0.90 (0.74 – 1.09)</td>
<td>0.28</td>
</tr>
<tr>
<td>Excluded foods/food groups</td>
<td>2.44 (0.00 – 2.44)</td>
<td>11.52 (1.22 – 109.02)</td>
<td>0.03</td>
</tr>
<tr>
<td>Experienced eating binges</td>
<td>-0.13 (0.00 – 0.13)</td>
<td>0.87 (0.71 – 1.07)</td>
<td>0.20</td>
</tr>
<tr>
<td>Vomited after meals</td>
<td>0.10 (0.00 – 0.10)</td>
<td>1.11 (1.01 – 1.20)</td>
<td>0.03</td>
</tr>
<tr>
<td>Used laxatives/diet pills/ diuretics</td>
<td>0.07 (0.00 – 0.07)</td>
<td>1.07 (1.01 – 1.14)</td>
<td>0.03</td>
</tr>
<tr>
<td>Used exercise to control weight</td>
<td>-0.01 (0.00 – 0.01)</td>
<td>0.99 (0.94 – 1.05)</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Symptomatic – participants that scored $\geq 20$ on the EAT-26; $^a$ – independent t-test $t_{40} = 3.7$, $P = 0.001$; $^b$ – Mann-Whitney U test; $^c$ – Fisher’s exact test; $^d$ – Pearson chi-square test.

Table 3. Direct logistic regression predicting likelihood of scoring $\geq 20$ on the EAT-26 test and indicating eating attitudes symptomatic of an eating disorder in undergraduate nutrition and dietetics students ($n = 91$).

3.5 Discussion

The results of this study indicate that a proportion (14%) of ND students had disordered eating attitudes symptomatic of an ED based on their EAT-26 scores. While this is similar to the prevalence reported in other studies on university students of various degrees and community samples, it is concerning given the possible implications for the future professional practice as dietitian or nutritionist. The ND cohort had a greater CR and lower EE scores than the OT cohort. There were no other significant variations between
the two groups. A large proportion of participants from both groups wished to weigh less, used exercise to control their weight, avoided certain foods from their diet or followed a dietary regimen. Individuals who scored as symptomatic on the EAT-26 were younger, had a lower self-esteem and scored significantly higher on all three scales of the TFEQ-R18 (UE, CR, and EE) than the rest of the participants. Enrolment in the first year of ND studies was the strongest predictor of symptomatic eating attitudes.

Previous research has reported a diverse range of ED risk in ND students from as low as 6%\(^9\) to 17%\(^{14}\) and 19%\(^{8}\) in students across the years of enrolment, to as high as 30%\(^7\) and 33%\(^{14}\) in students enrolled in year one of their study. In our investigation, despite no significant differences in eating attitudes within the ND cohort, enrolment in the first year of studies was predictive of high EAT-26 scores. Other predictors were UE and CR, however the odds ratio obtained for these characteristics suggests their small contribution to the EAT-26 scores in this sample. The greater odds for year one students may be related to a number of factors. Previous studies in nutrition cohorts showed a greater prevalence of disordered attitudes and behaviours in students just starting their studies and attributed decrease in these to an increase in nutrition-related knowledge.\(^{14,22}\) We have previously shown that, in this group, students from the latter years of study demonstrated greater nutrition knowledge.\(^{20}\) We also found that those in year one were more likely to follow a dietary regimen, however there was no relationship between being symptomatic of an ED and a following dietary regimen across all years of study. We cannot determine whether enrolment in the first year of study is a predictor unique to our sample or there are other factors that are relevant to this particular cohort. Longitudinal investigations would be of benefit to help understand the possible determinants of this phenomenon.

The lack of difference in EAT-26 scores and disordered eating between ND and OT cohort in our sample is supported by other comparative studies that showed no difference in ED risk between nutrition and other health\(^9\) and non-health\(^8,9\) degrees students. The overall proportion of symptomatic individuals in this research (approximately 13%) is within the range of previously reported in community sample (5% to 13%)\(^23\) and in university students enrolled in health (9% to 20%)\(^{13,24}\) and non-health (8% to 21%)\(^{15,24}\) degrees. The relatively wide ranges in the prevalence of ED make it challenging to
suggest whether nutrition-oriented degrees in particular, or health degrees in general, have an effect on eating attitudes.

However, we found some differences between the two cohorts. ND students in this study had significantly greater CR than the OT group. How to define a conscious restriction of food intake to reduce or control body weight.\textsuperscript{17,22} Other groups\textsuperscript{14,25} also reported higher prevalence of restraint in undergraduates majoring in nutrition. The relatively high CR in the ND cohort could have also been a contributing factor to EAT-26 scores in this group. Training in nutrition and dietetics may make individuals more focused on food and inadvertently lead to higher scores on EAT-26, as some statements of this instrument are related to thinking about the energy content and consumption of food. Clinical diagnoses through a follow-up interview for participants who scored $\geq 20$ on the EAT-26 were not within the scope of this study, therefore identified disordered eating attitudes could not be directly linked to an active ED.\textsuperscript{26} Additionally, similar scores obtained by ND students enrolled in different years of study in our sample could suggest that nutrition training does not exacerbate disordered eating. However, nutrition-related training may make students more conscious of eating and explain a higher CR seen in this cohort in comparison to the OT students. It is debatable whether increased CR is reflected in actual eating behaviour,\textsuperscript{27} therefore in our sample an elevated CR may be due to an increase awareness of food and nutrition, and not a symptom of an ED. Alternatively, EE was lower in the ND cohort in comparison to OT. This could suggest a susceptibility to overeating in response to experiencing a negative emotion, such as fear, anxiety, or stress,\textsuperscript{28,29} in the OT cohort, which has previously been linked to BMI\textsuperscript{30} and body image.\textsuperscript{28} We found no differences in the BMI between the cohorts in this study; therefore, this outcome could be investigated further to determine specific correlates of EE of students in health degrees.

Another concerning find of this study is a high proportion of participants from both cohorts that experienced eating binges, and, the smaller numbers that reported using laxatives, diet pills, diuretics and vomiting after meals. These disordered eating behaviours have been previously reported in university students enrolled in nutrition and non-nutrition degrees.\textsuperscript{8,15,31-33} For example, one study on body and weight attitudes and behaviours of dietetic students found that out of 74% of participants who attempted to
lose weight, up to 15% thought laxatives and up to 11% found vomiting after meals was helpful in weight loss.\textsuperscript{33} Another study in Australian teachers trainees\textsuperscript{32} reported that up to 13% were vomiting, and approximately 7% used laxatives and dietetic pills. In another study, 10% of students from mixed degrees across various years of enrolment admitted to binging.\textsuperscript{15} The use of these harmful weight reduction techniques has been previously attributed to the desire for a particular body ideal and weight loss.\textsuperscript{33} Indeed, the majority of participants in this study indicated that they wished to weigh less despite being in a healthy weight range.

It is feasible this study attracted students in both cohorts with a vested interest in dieting behaviours or potentially led to some students not participating due to pre-existing concerns with food or disordered eating. Therefore, the results may not be applicable to a broader population of ND and OT students. Our data did not differentiate between genders and therefore gender-specific disparities in disordered eating, such as those previously reported in the literature,\textsuperscript{13} could have influenced the outcomes. Furthermore, our study used self-reported anthropometric data that may be subject to personal bias, whilst answers provided to sensitive topic such as disordered eating may be subject to social desirability bias.\textsuperscript{34} Finally, due to the cross-sectional nature of this research, the links between progression in undergraduate ND studies and changes in eating attitudes and behaviours were not investigated. One longitudinal investigation\textsuperscript{35} suggested mean decrease in ED symptoms in undergraduate females of non-nutrition degrees, therefore longitudinal studies in ND cohorts are needed to determine the influence of vocational training on the eating attitudes and behaviours.

In conclusion, the results of this cross-sectional investigation suggest that, apart from CR and EE, ND students had similar eating attitudes and behaviours when compared to undergraduate students enrolled in another female dominated, health degree. Although the prevalence of disordered eating attitudes and behaviours in this sample was concerning, it was within previously reported ranges within similar groups. Participants from both cohorts demonstrated high dissatisfaction with body weight, as well as high prevalence of dietary exclusions and exercising for weight control. These findings will be of interest to university educators and professional bodies involved in nutrition and dietetic pathways in particular due to the nature of the work in nutrition counselling by
graduates from these degrees. Relatively high rates of identified disordered dietary behaviours indicate a clear need for further education and support for these students as they progress through their degree. Additionally, specific strategies to prevent, address and manage disordered eating should be developed in open dialog and collaborative effort from all stakeholders. For example, means of regular self-evaluation with an opportunity for self-referral to counselling services should be available to ND students in every year of enrolment, but particularly for those who are just starting their studies. Furthermore, educational institutions in conjunction with professional bodies could develop discipline-specific policies to ethically support the needs of students. A recent publication from the Academy of Nutrition and Dietetics has provided some insight into the issue of ED in nutrition students.\textsuperscript{2} Similar guidance would be of benefit for Australia.

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**Conflicts of Interest**

The authors had no conflicts of interest to declare.
3.6 References


Chapter 4: The relationship between dietary intake and energy availability, eating attitudes and cognitive restraint in students enrolled in undergraduate nutrition degrees

Introduction to Chapter 4

This chapter report results from the second phase of analysis from Stage 1 of data collection of this research. It presents a paper published in the journal Appetite. The paper contributes to an important, yet under investigated issue of energy balance and energy availability in active individuals. The manuscript presents results of dietary assessment of nutrition students and explores associations between energy intake, energy balance and energy availability and eating attitudes and cognitive restraint. To the author’s knowledge, this study is first to explore these associations in undergraduate nutrition students of both sexes.
Chapter 4: Relationship between dietary intake, energy status and disordered eating

Full publication reference

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Authors declaration

Tetyana Rocks was responsible for study design, literature search and summary, data collection, analysis and interpretation, and manuscript drafting and editing.

Associate Professor Fiona Pelly was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Gary Slater was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Lisa Martin was responsible for study design, data analysis and interpretation, and manuscript editing.
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The published version is available here: https://doi.org/10.1016/j.appet.2016.08.105
Chapter 5: Exercise addiction symptomology and disordered eating
Chapter 5: Prevalence of exercise addiction symptomology and disordered eating in Australian students studying nutrition and dietetics

Introduction to Chapter 5

This chapter presents results from the third phase of analysis from Stage 1 of data collection of this research. The chapter includes a peer-reviewed manuscript published in *Journal of the Academy of Nutrition and Dietetics*. This is a descriptive paper on the prevalence of exercise addiction in students studying nutrition and non-nutrition degrees in an Australian university. The manuscript also investigates links between exercise addiction and physical activity, and disordered eating attitudes and cognitive restraint.
Chapter 5: Exercise addiction symptomology and disordered eating

Full publication reference

This chapter is the peer reviewed version of the published manuscript: accepted version of the published manuscript:

**Rocks T, Pelly F, Slater G, Martin L. Prevalence of exercise addiction symptomology and disordered eating in Australian students studying nutrition and dietetics. J Acad Nutr Diet. 2017. DOI: 10.1016/j.jand.2017.04.001, which has been published in final form on Science Direct. This manuscript version is made available under the CC-BY-NC-ND 4.0 license [http://creativecommons.org/licenses/by-nc-nd/4.0/].**

Authors declaration

Tetyana Rocks was responsible for study design, literature search and summary, data collection, analysis and interpretation, and manuscript drafting and editing.

Associate Professor Fiona Pelly was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Gary Slater was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Lisa Martin was responsible for study design, data analysis and interpretation, and manuscript editing.
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Chapter 6: Body composition and disordered eating in a sample of Australian nutrition and dietetics students: a 1-year follow-up study

Introduction to Chapter 6

This chapter presents results from the fourth phase of analysis from Stage 2 of data collection for this thesis. The chapter consists of a manuscript which has been prepared for submission to the journal *Nutrition & Dietetics*. The manuscript examines changes in body composition, and eating and exercise attitudes over 1-year of university study in a sample of undergraduate nutrition and dietetics students in an Australian university.
Suggested manuscript reference


This chapter presents the aforementioned manuscript which has been prepared for submission. The final version of the paper may differ.

**Authors declaration**

Tetyana Rocks was responsible for study design, literature search and summary, data collection, analysis and interpretation, and manuscript drafting and editing.

Associate Professor Fiona Pelly was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Gary Slater was responsible for study design, data analysis and interpretation, and manuscript editing.

Dr Lisa Martin was responsible for study design, data analysis and interpretation, and manuscript editing.
Body composition and disordered eating in a sample of Australian nutrition and dietetics students: a 1-year follow-up study

6.1 Abstract

Aim: To investigate changes in body shape and associated eating and exercise attitudes and behaviours in a sample of undergraduate nutrition and dietetics students after 1-year of university study.

Methods: This follow-up observational study measured body composition, body shape satisfaction, eating attitudes, eating behaviours and exercise addiction using validated tools at two time points, one year apart, in 36 students studying nutrition and nutrition and dietetics (ND cohort), and occupational therapy (OT cohort) degrees.

Results: On average body composition did not change over the 12 months of investigation. However, on an individual level 32% of ND students increased their body mass (BM), 32% decreased BM and in 36% BM did not change. The changes in BM were associated with similar directional changes in fat mass (FM), but not in fat free mass (FFM). Eating and exercise attitudes remained stable, with some decrease in disordered symptoms on an individual level. Additionally, self-esteem increased and body shape concern decreased.

Conclusions: This study highlighted the importance of an individual approach when investigating BM and disordered eating issues. Results also suggested that in some individuals studying nutrition-related degrees may be associated with positive changes in body composition and body shape satisfaction. Furthermore, outcomes demonstrated that disordered eating and exercise attitudes were not exacerbated during nutrition-focused training. Further studies are needed to confirm these findings.

Key Words: body composition, body mass, eating attitudes, nutrition and dietetics students, weight gain, weight loss.
6.2 Introduction

Weight- and diet-related issues, such as body shape dissatisfaction and associated eating psychopathology, are prevalent in modern society. A university environment has been suggested as being a distinctive setting for both weight gain and disordered body and eating attitudes.\(^1,2\) Previous research has shown that weight gain is a prevalent phenomenon in university students, particularly in those just starting their study.\(^1,3\) Despite numerous authors having reported wide-spread pathological eating behaviours in student populations, currently there is no consensus as to whether disordered eating is exacerbated during the years of tertiary study.\(^4,6\) An increased prevalence of weight- and eating-related disorders has been attributed to a number of factors, from a broader perceived importance of appearance in modern culture, to more specific university-related determinants such as increased stress associated with a change in environment and studying.\(^7,8\) Additionally, for many students, time at university is an important step in self-concept formation which can be associated with the frequent comparison to perceived ideals and self-objectification. This can lead to body dissatisfaction and disordered eating attitudes and behaviours.\(^2\)

Undergraduate students studying nutrition and dietetic (ND) degrees represent a unique group within the university population. Firstly, the ND students are placed in the same environment as the other students, which is challenging and demanding. Additionally, during their degree-specific study, the ND students acquire substantial knowledge on health, healthy body weight and optimal dietary behaviours. Indeed, previously it has been reported that some ND students are motivated to study nutrition-focused degrees by their pre-existing weight- and eating-related issues.\(^9\) This has resulted in the investigation of body image and eating attitudes within this group.\(^10,13\) We have previously shown that ND students experience disordered eating, high cognitive restraint and body weight dissatisfaction.\(^14\) However, if body weight dissatisfaction appears to be common amongst this population,\(^10,11,13\) it remains unclear if body composition and disordered body and eating attitudes change during their university education. Therefore, the aim of this study was to investigate changes in body composition and eating and exercise attitudes of students enrolled in undergraduate nutrition and nutrition and dietetics degrees over the 12-months of university study.
6.3 Methods

This study is a one year follow-up of a cross-sectional investigation completed by our group on eating attitudes and behaviours in ND students,\textsuperscript{14} with previous approval from the University of the Sunshine Coast Human Research Ethics Committee (HREC S/13/525). Participants were undergraduate students enrolled in one of two nutrition-focused degrees: a three year Bachelor of Nutrition degree or a four year Bachelor of Nutrition and Dietetics degree. The comparator cohort consisted of students enrolled in a four year Bachelor of Occupational Therapy degree. The initial round of data collection occurred in August – November 2013 (Time 1 [T1]). Follow-up data was collected in August – October 2014 (Time 2 [T2]). One hundred and thirty seven (n = 119 females and n = 18 males) and 40 (n = 36 females and n = 4 males) students participated in data collection at T1 and T2 respectively. Follow-up analyses were conducted only on students who completed both data collection rounds (i.e., T1 and T2), as the aim of the study was to investigate the change over time in individual participants. To compare students who returned at T2 to those who did not return, we conducted a series of independent samples t-tests and Mann-Whitney U-Tests. This comparison showed no significant differences in any of the measured variables. Due to small number of returning males (n = 4), the data for these participants is not presented.

The first part of assessment included the completion of six online questionnaires. Disordered eating was investigated using the Eating Attitudes Test-26 (EAT-26)\textsuperscript{15} and the Three Factor Eating Questionnaire (TFEQ).\textsuperscript{16} Detailed description of these questionnaires is provided elsewhere.\textsuperscript{14,17} Briefly, the EAT-26 is a validated questionnaire which includes questions on eating attitudes, and dieting behaviours. Answers to attitude- and behaviour-based questions are summed to obtain the overall score. A score of $\geq 20$ may indicate an eating psychopathology symptomatic of an eating disorder. The questionnaire is not a diagnostic tool, but has been commonly used to screen for disordered eating.\textsuperscript{18} The TFEQ is a validated questionnaire which assesses three domains of eating: cognitive restraint, uncontrolled eating and emotional eating. Scores for each domain were summed and transformed on 0 – 100 scales. There are no specific cut-offs point with higher scores representing greater extent of behaviour.\textsuperscript{16}
Body shape concern was investigated using the Body Shape Questionnaire (BSQ8-D).\textsuperscript{19,20} The questionnaire is a validated scale that investigates affective aspects of body dissatisfaction. The tool used questions such as “Have you noticed the shape of other women/men and felt that your own shape compared unfavourably?” Responses were coded based on a 6-point Likert-type scale, from 1 for “never” to 6 for “always” and summed to obtain the total score (possible range of 8 – 48). The final score was allocated into one of four categories of body shape concern: 1) no concern (scores < 19); 2) mild concern (scores 19 – 25); 3) moderate concern (scores 26 – 33); and 4) marked concern (scores ≥ 34).\textsuperscript{20}

Exercise attitudes of the students were explored with the Exercise Addiction Inventory (EAI).\textsuperscript{21} This screening tool evaluates the perceived importance of exercise. It consists of six statements each dedicated to one of the components of addiction (i.e., salience, mood modification, tolerance, withdrawal symptoms, conflict and relapse). Each component has a corresponding statement (for example, for mood modification the statement is “If I have to miss an exercise session I feel moody and irritable”). Answers were based on a 5-point Likert-type scale from 1 for “strongly disagree” to 5 for “strongly agree”. These were summed to obtain a total (possible range of 6 – 36). The proposed cut-off for the EAI is 24 with a total ≥ 24 indicating a high risk of exercise addiction. A total score ≤ 12 is indicative of an asymptomatic individual, whereas a score within 13 – 23 range suggest the presence of exercise addiction symptoms.\textsuperscript{21}

Self-esteem was measured using the validated 10-statement Rosenberg Self-Esteem Scale (RSES).\textsuperscript{22} The scale includes questions such as “On the whole, I am satisfied with myself” and is answered on a 4-point Likert scale (from “strongly agree” to “strongly disagree”). The answers were coded and summed to provide a total within the range of 10 – 40, with higher scores corresponding with greater self-esteem.\textsuperscript{22} Finally, demographic, social and diet-related data were collected by a questionnaire which had been developed at T1 for the purpose of this research and is described elsewhere.\textsuperscript{14}

Following the completion of online questionnaires students undertook body composition assessment. On both occasions (i.e., T1 and T2) students received standardised instructions to present for assessment soon after awakening, fasted, wearing light, metal
free clothing. Stretch stature was measured on a Harpenden stadiometer (Holtain Limited, Crymych, United Kingdom) to the nearest 0.1 cm using a previously published protocol. Body mass (BM) was measured on a SECA scale (GmbH, Germany) to the nearest 0.01 kg. Dual energy X-ray absorptiometry (DXA) whole-body mode scans were performed using a Lunar DPS pencil beam scanner (GE Healthcare, Madison, WI) following a previously described protocol. Scans were analysed with GE enCORE software (Version 13.60, GE Healthcare). Fat free mass (FFM) was calculated as BM estimated by DXA (BM_{DXA}) minus fat mass (FM). Body Mass Index (BMI) was calculated based on BM estimated by DXA and stature (BM [kg]/stature [m^2]). Twenty six female students completed body composition assessments within 2 – 4 weeks of completing the online questionnaires.

The Statistical Package for the Social Sciences (Version 22.0, SPSS Inc., Chicago, IL, USA) was used to complete statistical analysis. Continuous data was checked for normality. Square root transformations were used in the analyses due to non-normally distributed scores for EAT-26 and TFEQ-R18. A paired t-test was used to compare variables at T1 and T2. Change was calculated by subtracting values at T2 from T1 (\( \Delta = T1 - T2 \)). Individual meaningful change in BM was defined as a change of \( \geq 3\% \) of BM_{DXA} at T1. BM_{DXA} measures were used in calculations to illuminate possible difference in presentation (i.e., clothing) at the times of assessment. Reliable individual change in outcomes for the scoring scales (i.e., the EAT-26, the TFEQ-R18, the BSQ8-D, the EAI and the RSES) was calculated using the following formula: 1.96 * SD1 * sqrt (2) * sqrt (1-r), where SD1 is the standard deviation of the variable and r is the reliability of the scale for that variable at T1. Pearson correlation was used to determine associations between changes in measured variables. Results were expressed as mean value ± standard deviation (SD), median value ± interquartile range (IQR), plus as number and percentage. The significance was set for \( P \) values < 0.05.

6.4 Results

Out of 36 female participants (median age 23.5 ± 15.0 years), 26 were enrolled in either Bachelor of Nutrition (n = 4) or Bachelor of Nutrition and Dietetics (n = 22) degrees. These were combined as the ND cohort. The remaining ten participants were enrolled in
the Bachelor of Occupational Therapy (OT cohort). The majority were enrolled in either year 2, 3 or 4 of their study with only three ND students reporting that the majority of the subjects they were completing at T2 were year one subjects.

No changes in mean body composition measurements between T1 and T2 were observed (Table 1). However, individual analysis of meaningful BM change revealed that over a 1-year period 32% (n = 6) of ND students experienced an increase in BM. The same number showed a decrease in BM (32%, n = 6) ND, while in 36% (n = 7) BM did not change from T1 to T2 (i.e., changes of ≥ 3% of BM at T1). A similar trend was evident in individual changes in FM (as % of BM and in kg), but not in FFM. Interestingly, BM-based group comparison (i.e., students grouped as BM-decrease, BM-increase and BM-no change) showed significant differences in BM, BMI and FM between BM-decrease and BM-increase at T1, but not at T2 (Table 2).

In the OT cohort, 30% (n = 3) of individuals experienced an increase in BM, 20% (n = 2) showed a decrease in BM, whilst 20% (n = 2) did not change from T1 to T2. However, unlike the ND cohort, changes in other measures of body composition (i.e., BMI, FM and FFM) did not follow the same trend. Additionally, within the OT cohort, BM-based group comparison did not reveal any differences in body composition at either point of assessment.

Eating attitudes and behaviours measured by the EAT-26 and the TFEQ-R18 did not change between T1 and T2 in the ND cohort. Exercise attitudes also remained stable (Table 3). However, the proportion of individuals demonstrating symptoms of an eating disorder (i.e., EAT-26 scores ≥ 20) decreased from 15% (n = 4) at T1 to 8% (n = 2) at T2. In addition, the proportion of students who reported following a dietary regimen or excluding foods or food groups from their diet decreased from 35% (n = 9) and 42% (n = 11) respectively at T1 to 27% (n = 7) and 39% (n = 10) respectively at T2. Similarly, the proportion of those who were at risk of exercise addiction decreased from 19% (n = 5) at T1 to 12% (n = 3) at T2. Mean body shape concern decreased significantly, whilst self-esteem increased significantly within the ND cohort. Proportionally, 69% of ND students were categorised as having concern with shape (n = 9 mild, n = 6 moderate and n = 3 marked) at T1 compared to 62% (n = 10 mild and n = 6 moderate) at T2. There
were no changes in the mean scores of the measured variables within the OT cohort (Table 3). Exploration of associations between changes in psychometric variables showed that in the ND cohort, decrease in disordered eating attitudes (i.e., EAT-26 score) correlated with both decrease in body shape concern and cognitive restraint ($r = 55, P = 0.003$ and $r = 49, P = 0.010$ respectively). In the OT cohort, decrease in body shape concern was associated with increase in self-esteem ($r = -0.76, P = 0.010$).

Individual assessments of change based on calculated criteria revealed that only a small proportion of students reported a reliable change over time for each measure of disordered eating. Notably, within the ND cohort, only a reliable decrease in symptoms of disordered eating, cognitive restraint, uncontrolled and emotional eating was reported (Table 4). A greater proportion of ND students showed a reliable decrease in body shape concern and exercise addiction symptoms and an increase in self-esteem (Table 4). The BM-based group comparison within the ND cohort revealed similar scores for all measured variables at both time points. Changes in these psychometric measures did not differ based on meaningful changes in BM.

Despite the overall decrease in body shape concern in the ND cohort, over half of the sample (54%, $n = 14$) stated that they were trying to lose weight, whilst the majority (81%, $n = 21$) were trying to change body shape at the time of follow-up. Interestingly, the body shape concern score did not vary between those who were trying to change shape and those who were not (20.9 ± 6.1 compared to 18.6 ± 5.0, $t_{24} = -0.776, P = 0.445$). Within those ND students who were trying to change their body shape at T2, 62% ($n = 16$) were trying to decrease body fat and 54% ($n = 14$) were trying to increase their muscle mass.
Table 1. Comparison of body composition between Time 1 and Time 2 (1-year follow-up) in undergraduate females enrolled in nutrition and dietetics (ND) and occupation therapy (OT) degrees.

<table>
<thead>
<tr>
<th>Measures</th>
<th>ND, n = 19</th>
<th>OT, n = 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>BM, kg</td>
<td>62.3 (12.9)</td>
<td>62.7 (10.9)</td>
</tr>
<tr>
<td>BM&lt;sub&gt;DXA&lt;/sub&gt;, kg</td>
<td>60.7 (13.0)</td>
<td>61.3 (10.3)</td>
</tr>
<tr>
<td>BMI&lt;sub&gt;DXA&lt;/sub&gt;, kg.m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>21.5 (4.3)</td>
<td>21.7 (3.5)</td>
</tr>
<tr>
<td>FM, %</td>
<td>32.7 (11.0)</td>
<td>32.2 (9.9)</td>
</tr>
<tr>
<td>FM, kg</td>
<td>20.1 (10.5)</td>
<td>19.7 (9.3)</td>
</tr>
<tr>
<td>FFM, kg</td>
<td>40.6 (5.2)</td>
<td>41.6 (4.7)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Cohen’s d</th>
<th>t</th>
<th>df</th>
<th>P</th>
<th>Cohen’s d</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM, kg</td>
<td>-0.03</td>
<td>-0.45</td>
<td>18</td>
<td>0.660</td>
<td>0.10</td>
<td>0.39</td>
<td>6</td>
<td>0.707</td>
</tr>
<tr>
<td>BM&lt;sub&gt;DXA&lt;/sub&gt;, kg</td>
<td>-0.04</td>
<td>-0.63</td>
<td>18</td>
<td>0.540</td>
<td>0.01</td>
<td>0.04</td>
<td>6</td>
<td>0.968</td>
</tr>
<tr>
<td>BMI&lt;sub&gt;DXA&lt;/sub&gt;, kg.m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>-0.06</td>
<td>-0.66</td>
<td>18</td>
<td>0.520</td>
<td>-0.03</td>
<td>-0.10</td>
<td>6</td>
<td>0.923</td>
</tr>
<tr>
<td>FM, %</td>
<td>0.04</td>
<td>0.40</td>
<td>18</td>
<td>0.691</td>
<td>0.40</td>
<td>1.47</td>
<td>6</td>
<td>0.191</td>
</tr>
<tr>
<td>FM, kg</td>
<td>0.04</td>
<td>0.50</td>
<td>18</td>
<td>0.623</td>
<td>0.48</td>
<td>1.25</td>
<td>6</td>
<td>0.257</td>
</tr>
<tr>
<td>FFM, kg</td>
<td>-0.20</td>
<td>-1.98</td>
<td>18</td>
<td>0.064</td>
<td>-0.27</td>
<td>-2.13</td>
<td>6</td>
<td>0.077</td>
</tr>
</tbody>
</table>

BM – body mass, DXA – dual energy X-ray absorptiometry, FM – fat mass, FFM – fat free mass.
Table 2. Comparison of body composition measures between Time 1 (T1) and Time 2 (T2, 1-year follow-up) in undergraduate females enrolled in nutrition and dietetics (ND) grouped according to individual changes in body mass.

<table>
<thead>
<tr>
<th>Changes in body mass</th>
<th>Eta squared</th>
<th>F</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decrease</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no change</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BM&lt;sub&gt;DXA&lt;/sub&gt; T1, kg</td>
<td>54.1 (13.9)</td>
<td>71.8 (12.4)</td>
<td>56.8 (5.8)</td>
<td>0.37</td>
</tr>
<tr>
<td>BM&lt;sub&gt;DXA&lt;/sub&gt; T2, kg</td>
<td>58.9 (12.7)</td>
<td>68.3 (11.6)</td>
<td>57.3 (5.1)</td>
<td>0.21</td>
</tr>
<tr>
<td>∆ BM&lt;sub&gt;DXA&lt;/sub&gt;, kg</td>
<td>4.8 (4.1)</td>
<td>-3.5 (1.0)</td>
<td>0.51 (1.1)</td>
<td>0.68</td>
</tr>
<tr>
<td>BMI&lt;sub&gt;DXA&lt;/sub&gt; T1, kg.m&lt;sup&gt;-2&lt;/sup&gt;</td>
<td>19.0 (4.0)</td>
<td>25.2 (4.7)</td>
<td>20.5 (2.0)</td>
<td>0.37</td>
</tr>
<tr>
<td>BMI&lt;sub&gt;DXA&lt;/sub&gt; T2, kg.m&lt;sup&gt;-2&lt;/sup&gt;</td>
<td>20.7 (3.7)</td>
<td>23.9 (4.4)</td>
<td>20.7 (1.7)</td>
<td>0.19</td>
</tr>
<tr>
<td>∆ BMI&lt;sub&gt;DXA&lt;/sub&gt;, kg.m&lt;sup&gt;-2&lt;/sup&gt;</td>
<td>1.8 (1.6)</td>
<td>-1.6 (0.7)</td>
<td>0.2 (0.4)</td>
<td>0.64</td>
</tr>
<tr>
<td>FM T1, %</td>
<td>27.3 (11.8)</td>
<td>41.6 (7.8)</td>
<td>29.6 (8.8)</td>
<td>0.33</td>
</tr>
<tr>
<td>FM T2, %</td>
<td>30.8 (11.3)</td>
<td>36.9 (9.7)</td>
<td>29.5 (8.8)</td>
<td>0.16</td>
</tr>
<tr>
<td>∆ FM, %</td>
<td>3.5 (3.4)</td>
<td>-4.7 (2.6)</td>
<td>0.1 (3.43)</td>
<td>0.77</td>
</tr>
<tr>
<td>FM T1, kg</td>
<td>15.4 (10.9)</td>
<td>29.3 (9.9)</td>
<td>16.2 (5.3)</td>
<td>0.37</td>
</tr>
<tr>
<td>FM T2, kg</td>
<td>18.5 (11.1)</td>
<td>24.9 (10.3)</td>
<td>16.2 (5.1)</td>
<td>0.16</td>
</tr>
<tr>
<td>∆ FM, kg</td>
<td>3.1 (2.0)</td>
<td>-4.4 (1.0)</td>
<td>0.04 (2.08)</td>
<td>0.77</td>
</tr>
<tr>
<td>FFM T1, kg</td>
<td>38.6 (4.6)</td>
<td>42.5 (5.2)</td>
<td>40.6 (5.6)</td>
<td>0.10</td>
</tr>
<tr>
<td>FFM T2, kg</td>
<td>40.4 (3.6)</td>
<td>43.4 (4.7)</td>
<td>41.0 (4.7)</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Chapter 6: Changes in body composition and disordered attitudes

$\Delta$ FFM, kg \hspace{2cm} 1.7 (3.1) \hspace{2cm} 0.9 (1.5) \hspace{2cm} 0.4 (1.8) \hspace{2cm} 0.07 \hspace{2cm} 0.56 \hspace{2cm} 2, 16 \hspace{2cm} 0.582

BM – body mass, DXA – dual energy X-ray absorptiometry, FM – fat mass, FFM – fat free mass, $\Delta$ – change, * – $P < 0.05$.

Table 3. Comparison of eating attitudes, behaviours, exercise attitudes, body shape concern and self-esteem between Time 1 and Time 2 (1-year follow-up) in undergraduate females enrolled in nutrition and dietetics and nutrition (ND) and occupation therapy (OT) degrees.

<table>
<thead>
<tr>
<th>Measures</th>
<th>ND, n = 26</th>
<th>OT, n = 10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>Time 2</td>
</tr>
<tr>
<td>EAT-26a</td>
<td>11.2 (11.2)</td>
<td>8.8 (8.8)</td>
</tr>
<tr>
<td>CRa</td>
<td>47.2 (15.1)</td>
<td>45.1 (19.2)</td>
</tr>
<tr>
<td>UEa</td>
<td>40.9 (17.7)</td>
<td>37.5 (18.0)</td>
</tr>
<tr>
<td>EEa</td>
<td>45.7 (22.5)</td>
<td>41.9 (22.1)</td>
</tr>
<tr>
<td>BS</td>
<td>23.7 (7.2)</td>
<td>20.5 (5.9)</td>
</tr>
<tr>
<td>EA</td>
<td>18.8 (4.8)</td>
<td>17.9 (4.3)</td>
</tr>
<tr>
<td>SE</td>
<td>18.5 (4.0)</td>
<td>19.9 (3.9)</td>
</tr>
</tbody>
</table>

Table 4. Individuals who reported reliable change from Time 1 to Time 2 (1-year follow-up).

<table>
<thead>
<tr>
<th>Measures</th>
<th>ND, n = 26</th>
<th>OT, n = 10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reliable change criterion</td>
<td>Reliable decrease n (%)</td>
</tr>
<tr>
<td>EAT-26</td>
<td>1.6</td>
<td>2 (8)</td>
</tr>
<tr>
<td>CR</td>
<td>1.7</td>
<td>2 (8)</td>
</tr>
<tr>
<td>UE</td>
<td>1.4</td>
<td>2 (8)</td>
</tr>
<tr>
<td>EE</td>
<td>2.1</td>
<td>2 (8)</td>
</tr>
<tr>
<td>BS</td>
<td>6.7</td>
<td>6 (23)</td>
</tr>
<tr>
<td>EA</td>
<td>6.1</td>
<td>5 (19)</td>
</tr>
<tr>
<td>SE</td>
<td>3.9</td>
<td>0</td>
</tr>
</tbody>
</table>

6.5 Discussion

The results of this study showed that as a group ND students did not appear to have any changes in body composition. However, on the individual level more than half students either lost or gained a meaningful amount of BM over a 1-year study period. Interestingly, grouping students according to BM changes demonstrated that those who had reduced BM at T2 had the highest mean BM, BMI and FM at T1, whilst those who gained BM, at T2 had the lowest means in these measures at T1. Consequently, all three groups of ND students (i.e., BM-decrease, BM-increase and BM-no change) were more uniform in their body composition at T2. This signifies that whilst the BM-decrease group had a mean BMI just above the healthy range (i.e., 18.5 – 25.0 kg.m$^{-2}$) at T1, this measure was well within the recommended optimal range at T2. In those who gained meaningful amount of BM, the mean BMI increase from the lower BMI cut-off, but remained within the healthy range. These changes in body composition in the majority of participants in our cohort were contradictory to the weight gain often reported in college population. A review summarising 17 previous investigations in university students has shown a common increase in BM by approximately 0.7 – 3.1 kg over 1 – 2 semesters. Furthermore, increases in BM tend to be associated with increases in FM and (in females) decreases in FFM. In our sample, the majority of those with an increase in BM had a BMI at the lower side of the healthy range at T1. Additionally, in most of those who decreased BM, a decrease in FM, but not FFM was also noted. Future research could explore motivating factors and means for body composition change in ND population to establish the important links between an increasing knowledge and personal aspects of change that could be used in optimal weight management.

The ND cohort reported a decrease in body shape concern and an increase in self-esteem (as a group and on an individual level). Furthermore, a decrease in body shape concern directly correlated with a decrease in disordered eating. This outcome supports previous research that established a clear link between body dissatisfaction and problematic eating attitudes. A decrease in body shape concerns is an important finding as the results of previous cross-sectional investigations indicated a wide-spread prevalence of body dissatisfaction in similar populations. Improvement in this characteristic in our sample could be attributed to a general age-related decline in problematic eating- and
weight-related attitudes. However, similar changes were not noted in the OT cohort. Therefore, the positive changes in our ND cohort may be specific to this sample, associated with distinct individual characteristics of those who participated. Additionally, these may be due to a unique presentation of this sample linked to a within-discipline culture. The study environment which equally encompasses educators and curricula has been shown to play an important role in students’ attitudes.\textsuperscript{27-29} It would be valuable to further explore this outcome in future investigations to establish psychological and behavioural determinants of positive body-related changes in the ND population.

Another important finding of this study is that all indicators of disordered eating attitudes and behaviours remained stable over time. On the individual level, a tendency towards a reliable decrease in the disordered symptoms was observed. The results of previous research did not reach consensus on whether problematic eating attitudes or behaviours change during tertiary study. Some authors reported that disordered eating may be exacerbated, for example in sorority women\textsuperscript{30} or in those just starting their university study.\textsuperscript{31} Other researchers suggested that disordered eating attitudes decrease, particularly in those undergraduate women who reported increase in body satisfaction and self-esteem.\textsuperscript{6} We also noted a decrease in body shape concern and increase in self-esteem, but the links between self-esteem and disordered eating symptoms were not apparent. This may be because in our sample, eating attitudes such as restraint are stable concepts and not related to self-esteem and BM. Furthermore, our earlier study showed that in the present sample cognitive restraint had no influence on dietary intake.\textsuperscript{32} Therefore, it could be proposed that, in the assessed cohort of ND students, cognitive restraint is a phenomenon independent of dietary restrictions and weight changes. Yet, the clear correlation between changes over time in cognitive restraint and disordered eating (measured by the EAT-26) in this sample could influence the EAT-26 assessment in this cohort resulting in higher scores. Thus, high cognitive restraint in ND students may be due to an increasing dietary and nutrition knowledge and not a symptom of an eating disorder. Further research in this eating behaviour domain in the ND population would be beneficial to support existing understanding of these concepts. It would also facilitate an improved screening of ND students to identify individuals in need of help with disordered eating.
This study had a number of limitations. Firstly, it is challenging to draw any associations between changes in body composition and other measured demographic or disordered eating characteristics due to the low number of participants in our follow-up study. Future research could explore these associations in a larger sample including male participants. A greater sample size will also allow for comparison of students according to their year of enrolment to explore whether changes in any of the measured variables are associated with a particular stage of ND tertiary training. A greater comparator sample of students from other health and non-health degrees would also help to clarify if the reported changes in body composition and body shape dissatisfaction are distinctive to the ND population. Secondly, this study collected data at only two points in time. To facilitate the existing understanding on weight and weight-related disordered eating changes in the studied population, longitudinal monitoring is warranted. Additionally, it would be interesting to investigate these topics in graduate nutritionists and dietitians to explore how personal weight- or eating-related issues (if present) influence their professional practice.

In conclusion, the results of this study highlight the importance of an individualised approach in investigations of BM and disordered eating related issues. It showed that in some individuals ND training may be associated with positive changes in body composition and body shape satisfaction. Eating and exercise attitudes remained stable within the ND cohort, however when change did occur, the tendency was for a reliable decrease in disordered symptoms. These results suggest that, despite previously expressed concerns about problematic eating and weight attitudes in this population, progressive study in nutrition-focused degrees may be associated with improvement in these issues. Further studies with longer periods of follow-up and greater numbers of participants are needed to confirm these outcomes.

**Funding**

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Conflicts of Interest

There were no conflicts of interest to declare.
6.6 References


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Chapter 7: Discussion and recommendations

Introduction to the Chapter 7

This chapter summarises the key findings presented in Chapters 3 – 6 (section 7.1.1) and discusses the main emergent themes identified in this research (section 7.1.2). The overall limitations of this research are summarised in section 7.2. Directions for future research are outlined in section 7.3. The recommendations for educational and professional bodies involved in tertiary training of nutrition and dietetics (ND) students are presented in section 7.4. The overall summary of the thesis is included in section 7.5.
7.1 Overview of findings and emergent themes

7.1.1 Overview of findings
The primary aim of this research was to describe eating attitudes and behaviours of students undertaking tertiary training in nutrition and dietetics and nutrition undergraduate degrees and to compare these with students studying a non-nutrition degree. The results concur with the literature showing that the ND students in our sample presented with a range of disordered eating attitudes and patterns. The overall prevalence of eating disorders symptomology was 14%, which was similar to the comparison cohort of OT students and to data reported by previous studies in other populations, such as university students and community samples. The majority of ND students indicated a perceived ideal weight below their current weight and over half (56%) stated they used regular exercise to manage their weight. This was despite the median Body Mass Index of students (22.4 ± 4.6 kg/m\(^2\)) being within the healthy range. Over half of the sample followed dietary regimens or excluded foods and food groups from their diet. Those enrolled in year one of their studies reported greater prevalence of dieting compared to students enrolled in subsequent years. There was no difference in eating attitudes and behaviours between ND and OT students. However, the ND students reported greater cognitive restraint and lower emotional eating than the OT students. Overall, although the prevalence of disordered eating attitudes in the ND students was similar to the prevalence reported in other populations, this was a concerning finding given the possible implications for the future professional practice as a dietitian or nutritionist.

The second aim of this research was to explore associations between eating attitudes and behaviours and other psychological and physiological factors in the ND cohort. Exploration of the dietary intake of this sample suggested that energy or macronutrient intake was not related to eating disorder symptomology or cognitive restraint. Despite this, it was revealed that females with high cognitive restraint had lower energy availability due to greater exercise energy expenditure when compared to those with low cognitive restraint. This relationship was confirmed by significant correlations between disordered eating attitudes, cognitive restraint and energy availability. The link between eating and exercise attitudes in the current sample of ND females demonstrated that those with eating disorder symptomology and high cognitive restraint reported greater exercise
addiction symptomology and higher volume of physical activity. This association between eating and exercise attitudes was not evident in males. Overall, 23% of ND students were found to be at risk of exercise addiction, whilst the majority demonstrated some symptoms that might indicate problematic exercise attitudes and behaviours. Therefore, it appeared that in this sample of ND students, exercise attitudes and behaviours were prominently aligned with eating- and body-related attitudes and behaviours.

The final aim of this research was to examine changes in eating attitudes and behaviours of ND students over one year of university study. The results of the follow-up assessment showed that the majority of the psychometric characteristics (i.e., eating and exercise attitudes, cognitive restraint, uncontrolled eating and emotional eating) remained stable over the 1-year study period in this sample. However, a reliable decrease in symptomology was noted on an individual level in all domains of eating attitudes and behaviours, as well as in exercise addiction symptomology. The proportion of ND students with scores indicative of eating disorder almost halved from 15% to 8%. A small decrease was also noted in those who reported following dietary regimens (from 35% to 27%). Students also reported an increase in self-esteem and improvement in body shape dissatisfaction. Interestingly, almost two thirds of ND females either gained or lost a meaningful amount of body weight, primarily as body fat. The individual changes in body composition increased the similarities in body weight and shape presentation of the sample.

7.1.2 Emergent themes

This research identified several emergent themes, which will be further discussed in the context of the published literature. The interconnected nature of eating attitudes and behaviours has been clearly shown in the results. However, the outcomes of the current investigation suggest a modified representation of the interrelationship of these concepts (Figure 1). Compared to the baseline depiction (Figure 1, Chapter 1 [page 3]), several topics within the interconnected domains (i.e., eating attitudes and behaviours, dietary intake and energy status, exercise attitudes and practices and body composition and body satisfaction) were most prominent in the investigated population.
One of the key results was the relatively high cognitive restraint in the ND students in comparison to the OT students. To date, there have been limited studies investigating cognitive restraint in students from nutrition-focused degrees with all of these reporting a greater restraint in this population.\textsuperscript{1,2} These studies, published in 2014\textsuperscript{1} and 2015,\textsuperscript{2} studied South African\textsuperscript{1} and Dutch\textsuperscript{2} samples of students and used different versions of the scale employed by this research to assess the restraint. The former study employed a full version of the Three Factor Eating Questionnaire,\textsuperscript{3} whilst the latter utilised the Dutch Eating Behaviour Questionnaire.\textsuperscript{4} This research used a short, revised version of the Three Factor Eating Questionnaire\textsuperscript{5} to decrease participation burden. Additionally, the scores for cognitive restraint obtained by participants in the current research appear to be above the scores previously reported in two separate studies using the same scoring system. These studies were conducted in a larger sample of young obese females,\textsuperscript{6} and in a population-based study of normal weight adolescents and adults.\textsuperscript{7} It is challenging to further interpret this finding due to the lack of studies in ND student populations and the use of dissimilar psychometric tools.

Figure 1. Graphical representation of the key emergent themes identified in this research.
Nevertheless, in this sample, high cognitive restraint emerged as one of the correlates for suboptimal energy status (Figure 1). However, this was related to exercise expenditure and not due to a low energy intake, as energy consumption was similar in individuals with high and with low cognitive restraint. Our results support a previous suggestion that cognitive restraint and restrained eating (e.g., dieting, or sub-optimal consumption of energy) might be functionally distinct concepts.\(^8\)\(^9\) Interestingly, in our sample, cognitive restraint was similarly high in individuals who reported following and not following a dietary regimen. The high proportion of students that followed a self-prescribed dietary regimen or excluded foods and food groups from their diet is another interesting finding of this study. The results showed that energy and macronutrient intake did not vary between those who did and did not report following a dietary regimen. This suggests that, although some of the ND students might be deliberately controlling their energy status, this control is more apparent in energy expenditure than in energy intake.

Low energy availability due to high exercise energy expenditure in ND females with high cognitive restraint is explained by greater exercise addiction symptomology and a higher volume of physical activity reported by this subgroup (Figure 1). The correlation between cognitive restraint and exercise supported by two other outcomes of this study: high exercise symptomology and high prevalence of exercise for weight control reported by participants. Although exercise and physical activity is undoubtedly one of the optimal avenues of weight management,\(^10\) in some of the ND students excessive exercise may be of concern due to the compromised energy status and its consequences for physiological and psychological health.\(^11\)-\(^17\) Furthermore, excessive exercise that is used as a compensatory mechanism is one of the symptoms of clinical eating disorders.\(^18\) In this sample, the eating component of attitudes and behaviours correlated with exercise attitudes and behaviours. Therefore, it is possible that ND students might perceive physical activity as a healthy compensatory medium for weight management. Additionally, nutrition degrees at the University of the Sunshine Coast may attract a higher proportion of students who have a specific interest in sports nutrition due to staff strengths in this area. Thus, the exercise attitudes and behaviours of the ND cohort in this research sample may not be representative of ND student populations from other settings.
Finally, this research agreed with previous investigations reporting a wide prevalence of body weight and shape dissatisfaction in ND student populations.\textsuperscript{19-21} This outcome is not unexpected given societal pressure on physical appearance.\textsuperscript{22,23} However, the majority of participants in this study were within the healthy weight range. Furthermore, over 12 months of study two thirds of ND females who returned for the follow-up stage either lost or gained weight leading to a more uniform appearance within the healthy range (please refer to Appendix 15 for a graphical representation of this outcome). The follow-up study also suggested a decrease in pathological body-shape preoccupation (evident by a decrease in the measured scores) that correlated with a decrease in disordered eating and cognitive restraint (Figure 1). It is possible that this outcome is attributed to a specific group of ND students. However, these results offer a promising outlook for future studies to explore ND study environments that may foster a positive shift in body-related issues.
7.2 Limitations of this research

The articles based on the findings of this research (chapters 3 – 6) have discussed the specific relevant limitations of each study. This section provides the overall limitations of this thesis.

The main limitation of this research is that it is challenging to examine cause-effect relationships in cross-sectional research. To address this limitation the project included a follow-up phase. However, the data was collected at two time points only. Future studies should continue exploring eating attitudes and their psychological and physiological determinants and consequences longitudinally, with data collected at regular time intervals throughout the tertiary training of ND students. Additionally, it is important to explore these issues in nutrition professionals, newly graduated nutritionists and dietitians through to more experienced practitioners. Continuation of longitudinal research in this population will strengthen the existing understanding of disordered eating in the ND group. It would also facilitate a better understanding of the impact of studying nutrition over a longer period of time. Furthermore, it would allow identification of trends in eating and exercise psychopathology, which may help determine times of particular vulnerability. Our research group has collected some of the additional follow-up data from the ND students that have participated in Stage 1 of data collection in 2013. Analysis of these data will assist to facilitate the existing knowledge on changes in eating attitudes and behaviours during the final years of university study.

Another important limitation is the restrictive nature of the screening tools used to assess eating attitudes of the ND students. Although this point was discussed in Chapter 3 of this thesis (p. 89), it is worthy of additional explanation. Two validated measures of eating attitudes and behaviours, the Eating Attitudes Test (EAT-26)\(^{24}\) and the TFEQ-R18\(^{5}\) include items that could potentially lead to an overall elevated score in individuals with an increased interest in food and nutrition. For example, the EAT-26 contains statements such as “I give too much time and thought to food”, “I find myself preoccupied with food” and “I am aware of the calorie content of foods that I eat.” Positive answers to these statements could be useful in identifying an individual with an obsessive preoccupation with food. However, these might not be appropriate in identifying dysfunctional
relationships with food in those studying nutrition and dietetics as these character traits are necessary to acquire the nutrition knowledge essential for competency in the profession. Similarly, the cognitive restraint scale of TFEQ-R18\textsuperscript{5} includes items that may elicit positive response due to an increase awareness of different foods and nutrition principles. For example, statements such as “I do not eat some foods because they make me fat” and “How frequently do you avoid ‘stocking up’ on tempting foods” may be scored highly by the ND students due to the learning curricula focused on healthy eating. Although the high cognitive restraint in this research was established based on median split, the tool could be adapted for the specific population, as recommended in Section 7.3. Additionally, these screening measures were not followed by interviews to determine the extent of disordered attitudes of the participants. These factors should be considered in interpretation of the results.

Furthermore, it is important to note the current inconsistency in the literature for estimating the energy availability (EA).\textsuperscript{25,28} In this research, EA was estimated as energy intake minus exercise energy expenditure (EA = EI – EEE). Exercise included planned and unplanned physical activities, such as vigorous, moderate and light exercise, and walking. Therefore, the EEE consisted of energy expended on these activities (refer to Chapter 4 for further details). However, other authors\textsuperscript{25,29,30} maintain that EEE should be estimated base on planned activities only. This method of estimation would decrease EEE and, consequently, increase EA. One study in a small group of young active women showed that calculating EEE based on all physical activities (i.e., planned exercise and unplanned activities such as walking or biking to commute) led to the lowest EA compared to other methods in which only planned exercise were used in calculation of the EEE. This method also led to a higher number of individuals with low EA.\textsuperscript{25} In this research, 18% of ND students presented with low EA. However, due to the calculation method, this proportion may have been overestimated.

An additional limitation is the absence of information on menstrual status of the female participants. This information would have strengthened the analysis of disordered eating and exercise attitudes in this group. This is due to growing evidences on the links between menstrual dysfunction and restraint eating, high physical activity and low energy availability.\textsuperscript{25,26,28,29,31} Future studies in this population should address this limitation to
enhance the existing understanding of the influence disordered eating and exercise have on female physiological functions.

Another potential limitation is the pooled data analysis conducted on students enrolled in the Bachelor of Nutrition and Dietetics and Bachelor of Nutrition. This was due to a low number of participants, particularly from the Bachelor of Nutrition degree. Nevertheless, some comparison analysis undertaken between these two cohorts showed no significant differences in the studied outcomes. A greater number of participants could have produced more distinct data for each cohort to explore specific characteristics related to nutrition and dietetics and nutrition students. The similarity between these two groups could have been due to particular presentation of this sample and may not be generalisable to other populations of nutrition and dietetics and nutrition students. Moreover, this research focused on undergraduate students of ND degrees. Therefore, the results may not be representative of ND student populations that are studying at a post-graduate level.

Additionally, this study did not compare ND students based on a grouped age. The age range of ND students who have chosen to participate in this study was 18 – 51 years. It is possible that in a sample with a greater number of participants, analyses of data based on age groups (e.g., < 25, 26 – 44 and > 45 years) could help to determine whether some of the explored variables, for example dietary behaviours, vary depending on age. Furthermore, the mean age of student participants in this research was 27.0 ± 8.7 years (range 17 – 51). This mean approximated the average age of 25 years reported in the University of the Sunshine Coast Key Statistics report, however, was more mature than samples of students described in previous literature. Frequently, a greater prevalence of disordered eating has been reported in younger individuals, particularly women. However, several recent authors have presented evidence that problematic eating attitudes and behaviours can also occur in middle life. Nevertheless, it is important to consider the age of students that participated in this research during interpretation and generalisation of the outcomes.

The final limitation is the voluntary nature of participation in this project. Prior to the data collection (as explained in Chapter 1 of this thesis) the author promoted this research to all eligible ND and OT students. During this promotion, the prospective participants
received a detailed description of the nature of data to be collected in this research. Therefore, it is feasible that some students decided not to take part in the study. Furthermore, it is possible that some of those who have participated provided preconceived answers to sensitive questions. In addition, it is feasible that only students who experienced changes in their body composition or eating and exercise attitudes and behaviours volunteered to participate in the follow-up data collection. Thus, it is challenging to conclude whether reported individual changes in these parameters are representative of the overall dynamics in this population.
7.3 Directions for future research

Several directions for future research have been outlined in the discussions of each manuscript (chapters 3 – 6) and the emergent themes (section 7.1.2). This section provides integrated suggestions for prospective investigations that are based on the consolidated outcomes of this project. The suggestions are grouped into three general topics:

1. **Development and validation of interventions in tertiary setting**

Future research should build on the current evidence provided by several reviews to assess the effectiveness of available interventions for disordered eating and body-related issues in university settings. It would also be important to include information and education on excessive exercise and exercise addiction. No interventions focusing on the specific needs of ND students with these issues have been identified to date. However, successful university-based interventions focusing on a healthy body image, decreasing eating disorder risk and excessive exercise prevention have been developed and evaluated in undergraduate students studying health and physical education. These programs employed a combination of summative and formative curriculum-based activities. The theoretical framework for these programs was structured on cognitive dissonance-based education that, together with acknowledgement of existing issues and active support, facilitates positive changes in attitudes. During several phases of interventions, which were integrated into a usual 12-week university semester, the standard course content was enhanced by self-concept, self-esteem, resilience and media literacy programs. Students participated in several class and discussion board activities that encouraged them to voice their own experiences, and their perspective on future teaching of weight and body issues, food and nutrition, exercise, self-esteem and body image. Evaluation showed that these programs produced a positive shift in self-esteem, body image and disordered eating. Similar interventions could be developed and evaluated in the ND students.

In addition, common features of effective programs that may be applicable to this population could include a combination of a cognitive and behavioural approach that is directed towards self-esteem enhancement; psychoeducation on negative body image (for example, determinants and consequences); body acceptance and satisfaction; and dealing with socio-cultural pressures. Furthermore, computer- and web-based
interventions for mental health issues have shown promising results in university student populations.\textsuperscript{47,48} Thus, future investigations should consider employing this form of delivery to protect the anonymity of the potential participants.

2. Development and validation of new assessment tools

It is recommended that future investigations focus on benchmarking normative measures of eating attitudes in ND population. This is due to content of some of the screening measures. As discussed in Section 7.2 of this chapter, both questionnaires commonly used in assessment of eating-related characteristics,\textsuperscript{1,49-53} EAT-26\textsuperscript{24} and TFEQ-R18,\textsuperscript{5} may lack sensitivity to differentiate between individuals with obsessive preoccupation with eating and those with an increased interest in the topic due to their area of study. Therefore, new measures of eating attitudes should be developed based on comparison studies between clinical samples, ND student samples, ND working professional and wider population-based samples.

The majority of mixed-sex investigations on disordered eating\textsuperscript{54-58} utilise measures developed in adolescent and young women (e.g., the EAT-26,\textsuperscript{24} the Body Shape Questionnaire\textsuperscript{59}). However, with the growing prevalence of eating psychopathology in middle- and older-age women and in men across the age groups,\textsuperscript{54,37,38} it is important to obtain a base knowledge on normative data specific for these groups. For example, results of one recent Australian study of 284 adult men that assessed several psychometric tools on disordered eating and body attitudes suggested that it is valuable to include measures which capture both ends of the spectrum (i.e., drive for muscularity and drive for thinness).\textsuperscript{60} In addition, future investigations should aim to validate the currently available screening cut-offs by comparing clinical samples of males and females of different age groups with population-based data.

Finally, future research should aim to develop valid methods of region-specific dietary assessment, such as food frequency questionnaires, that would be effective in capturing a diverse range of dietary regimens. This research utilised the Cancer Council Victoria Dietary Questionnaire for Epidemiological Studies (DQESv2) due to the limited number of tools validated in the Australian context (please refer to section 1.4.3.3 and Appendix 5 for further information) at the time of this study. As this questionnaire was developed
in an older group, other authors have recently reported that it may not be adequate to estimate intake of foods and food groups consumed by younger individuals, such as some discrentional and novelty foods.\textsuperscript{61} The results of this research also showed that the questionnaire may not be suitable to estimate intake in individuals with dietary restrictions (e.g., vegetarians or those who do not consume wheat), and those who consume energy-contributing supplements, such as protein powders. A more recently developed tool which was not available in on-line form at the time of data collection for this project, the Australian Eating Survey,\textsuperscript{62} has been created to include a broader range of foods and to capture additional dietary information, such as the use of vitamins. The tool has been originally validated in children and adolescents,\textsuperscript{63} and showed acceptable results in comparison to weighed food records in 97 middle-age adults in a 2014 study.\textsuperscript{62} However, dietary preferences and food consumption has shown to vary depending on age and other demographic and social circumstances.\textsuperscript{64,65} Therefore, future studies should consider development and validation of age- and population-specific self-administered tools effectively assessing intake of a broad range of foods and supplements.

3. **Longitudinal and qualitative research**

Outcomes of this research suggested some individual improvement in body shape satisfaction and eating and exercise attitudes in the female ND group. Other authors have reported similar results in university students studying other degrees besides nutrition.\textsuperscript{66} However, it would be important to continue assessing nutrition and dietetic professionals during their earlier years post-graduation and further into professional life. For example, one longitudinal investigation showed that the university environment predicted disordered eating symptomology 10 years after graduation.\textsuperscript{67} Therefore, future research should explore if and how individual eating and body attitudes change whilst graduates emerge as new professionals. It would also be interesting to explore the main predictors of these changes in a group of newly practicing dietitians and nutritionists. For example, future studies could aim to determine the specifics of a learning environment that may facilitate positive changes in disordered attitudes. Additionally, it would be interesting to continue investigating the exercise attitudes of ND students and the relationship between eating and exercise attitudes in this group.
Results of this thesis could also inform future qualitative studies that can explore in-depth eating- and body-related attitudes of ND students and how and why these form and occur. The current findings suggest a diverse sample; therefore, a qualitative approach would facilitate non-unitary exploration that could help capture the unique presentation of this population. Additionally, it is crucial to continue studying body shape attitudes in this population to understand individual experiences and perceptions of body and shape satisfaction. An embodied research that is built on a concept of “lived experience” could be adopted to illustrate students’ perspective in a range of situations and environments. Finally, it would be valuable to explore social influences on eating and weight-related topics in undergraduate students. Earlier research reported a strong link between fear of negative evaluation and restrictive eating attitudes and negative body image, whilst other authors suggested that ND students may feel that their eating and body habits have been evaluated by others due to the nature of their nutrition-focused training. Future research should explore how ND students perceive and position themselves and if (and how) this self-view changes during their tertiary education.
7.4 Recommendations for educational and professional bodies

There are three key recommendations for the educational and professional organisations involved in teaching and training of ND students.

1. Development of curriculum-based activities

It is recommended for the educational bodies involved in tertiary training of ND students develop curriculum-based activities promoting self-care and self-compassion. The first aim of these activities is to encourage the development of the topic-specific reflective skills that could facilitate self-assessment, and to promote self-compassion and self-care regarding body- and eating-related issues in students. Unlike in disordered eating interventions, the focus of these activities should be on overall psychological and physiological well-being. This would be of advantage to encourage openness by reducing the stigma associated with problematic eating and body dissatisfaction. An emerging body of research has consistently recognised self-compassion and self-care as two of the main factors linked to lower levels of disordered eating and body attitudes. In addition, self-compassion has been suggested as a key protective element in prevention of eating and body pathology.\textsuperscript{73-77} Self-compassion, or ability to be aware of one’s own needs, understanding of one’s own experiences and nonjudgmental attitudes towards one’s own shortcomings, could be mastered and is considered to be helpful coping mechanisms for academic and personal stress.\textsuperscript{78,79} Therefore, a curriculum-based activity facilitating building of self-compassion would be equally helpful for students with and without disordered body and eating attitudes in developing health and well-being promoting skills.

The second aim of the recommended curriculum-based activities is to facilitate capacity and resilience building for future professional practice. Dietitians and nutritionists often work with individuals and communities with physical, economic and social disadvantages.\textsuperscript{80-83} Therefore, a career in ND can be challenging and confronting.\textsuperscript{81,82,84-86} This type of work places high emotional demand on an individual and could lead to low work (and personal) satisfaction, emotional and physical exhaustion, and burnout.\textsuperscript{84,87-90} Furthermore, professional satisfaction, growth and retention rates in ND could directly affect quality of care provided to the public.\textsuperscript{81,82,86} Research conducted into
these issues has shown that a notable proportion of individuals in the ND workforce experienced job dissatisfaction, low levels of personal accomplishment, and high levels of exhaustion.\textsuperscript{82,84,89,90} For example, a survey of over 400 registered Canadian dietitians has shown that over half of the group (57%) experienced moderate to high levels of burnout.\textsuperscript{84} Another assessment in South African registered dietitians (n = 340) revealed a low satisfaction with employment in almost two thirds (66%) of the participants.\textsuperscript{82} The latest study in Australian dietitians (n = 225) supported these findings by showing that although the overall level of burnout in this profession was slightly lower than that reported in other health professionals, over 20% of hospital dietitians surveyed demonstrated emotional exhaustion.\textsuperscript{89}

The main factors relating to job satisfaction in the ND profession have been identified in another Australian study.\textsuperscript{81} The results of this research, which was based on focus group interviews, showed that practicing dietitians uniformly value recognition, professional development and a supportive environment. However, the researchers concluded that job satisfaction is multifactorial and a highly individualised concept.\textsuperscript{81} The individualised approach and personal characteristics as determinants of job performance and satisfaction are well documented concepts.\textsuperscript{91,92} Another important determinant of career satisfaction and professional performance is adequate training and self-care. Yet, a 2014 survey of acute care dietitians in Queensland revealed that the majority (92%) of these professionals stated they either did not receive or do not recall receiving self-care training during their tertiary study.\textsuperscript{90} Therefore, curriculum-based activities facilitating development of students’ individual resilience and capacity for managing emotional and physical stress of future professional practice through self-compassion and self-care should be of high relevance to educators and professional bodies involved in university ND degrees.

2. Facilitation of a supportive environment

It is also recommended that educators encourage and facilitate continuous discussion about problematic behaviours related to diet and exercise. Educators play a crucial role in adaptation of students into the study environment and in development of students into future professionals.\textsuperscript{85} Therefore, the attitudes and beliefs of educators could provide an inspirational turning point for students who may have personal issues with disordered eating or weight management for improving self-esteem in these individuals. Educators
should aim to maintain a learning culture that is based on mentoring relationships to inspire a positive change. Educators should also facilitate a supportive and inclusive learning environment that promotes an open, non-judgemental conversation on topics related to food and body perceptions of students.

In addition, development or adaptation of self-evaluation, self-referral and self-help tools which allow for a private individual assessment of body dissatisfaction and disordered eating should be considered. These comprehensive resources should include several topics, such as general and population-specific information on symptomology; summary of available evidences; explanation of possible ramifications for an individual and public health and well-being; and provide information about support mechanisms and treatment options available. It is important to adapt this material to the specific needs of the ND population. In particular, it would be important to include explanation on how the dynamically increasing knowledge on food, nutrition and health may trigger dissatisfaction with appearance or performance. It would be also useful to provide information and statistics on dietitians and health professionals with a history of eating disorders. This could help reduce the stigma associated with the issue, as well as decrease feelings of isolation and ultimately encourage seeking help. These resources should be developed in collaboration with student bodies to represent the opinions and needs of the ND student population. Similarly to the curriculum-based activities recommended above, these resources should be made available to students earlier in their enrolment with regular revisions encouraged throughout the years of study.

A noteworthy example of an educational activity with the focus on capacity building for future practice is an internet-based tool developed by researchers in affiliation with the American Medical Student Association. The main purpose of the tool was to encourage self-care and health promotion in medical undergraduates and to create a supportive learning environment. The tool included three broad areas related to self-reflection, positive habits and health education. The anonymous, internet-based nature of this tool protected confidentiality and supported a non-judgemental approach. The tool included a series of questions and reflective activities that enabled the development of an on-going individual self-care plan. Overall, the resource was accessed over 10500 times in a period of one year. Evaluation of the first 500 student participants revealed that tool was
perceived as helpful in understanding of personal care and health (89%), learning new health strategies (83%), and developing better understanding of personal health-related characteristics (53%). Additionally, more than half of students (51%) thought that this personal health tool would help them to communicate self-care issues in the future practice. Similar educational portals could be developed specifically for ND students to promote positive reflective approach to university study and future professional practice.

3. Development of specific guidelines
Finally, it is recommended that educational bodies offering university-based ND and OT programs instigate the development of supportive mechanisms for students struggling with disordered eating and body image. This research showed that prevalence of eating- and body-related issues were similar between these health-focused degrees and may be applicable to other degrees focused on health. Therefore, it is important to create a cross-institutional framework for students who are in need of supportive mechanisms. This should be developed in collaboration with each specific discipline to ensure meeting of discipline-related requirements. Professional bodies may also play a role in producing resources that can used by educational institutions as part of the education process. The proposed actions are crucial to protect all parties potentially affected in such circumstances: the student, the educational body and the wider public. This is not a novel recommendation, with first published evidence of similar suggestions dating back to 1989. In the almost three decades that have followed, several researchers who had investigated similar issues in ND and other health students, expressed concerns and called on educational and professional organisations to seek collaborative solutions. However, a survey of educational institutions that are training ND students conducted in 2012 showed that only 15% had procedures in place. This thesis discussed a proposal from the Academy of Nutrition and Dietetics on how to address the ethical dilemmas associated with clinical eating disorders in dietetics students (please see Chapter 3, page 91). The document provides a process of addressing ethical dilemmas in dietetic practice and lists steps for assessing such situations and determining possible options. The document could provide an initial framework that should be adapted to the Australian context to protect individual and the public health and to ensure an ongoing integrity of ND and OT education.
7.5 Conclusion

This research investigated disordered eating attitudes and behaviours and associations of these factors with a range of physiological and psychological characteristics in undergraduate ND students. Changes in eating- and weight-related attitudes and body composition over one year of study were also examined. The results showed high cognitive restraint, body shape dissatisfaction, and exercise addiction symptomology in the study sample. It was demonstrated that younger students and those who are just starting their study might be at greater risk for disordered eating. It appeared that disordered eating and cognitive restraint were associated with exercise addiction in females. Consequently, disordered eating attitudes and cognitive restraint were linked to greater exercise energy expenditure and low energy availability in this group. Progressive training in nutrition-focused degrees was not associated with worsening in disordered attitudes. On an individual level, some improvement was noted in all domains of eating and exercise attitudes, whilst body shape dissatisfaction decreased and self-esteem increased after 12 months of study. Therefore, despite the reported prevalence of disordered eating and exercise attitudes and behaviours, ND study may be associated with a positive change in these issues.

The outcomes of this investigation provided several possible directions for future research. In particular, it would be useful to advance tools currently used in assessment of eating and body attitudes and behaviours by including normative standards for diverse populations. Additionally, in the future it is important to employ longitudinal and qualitative study designs to explore the determinants of eating- and weight-related attitudes and behaviours in ND population and to establish factors that foster positive changes. Finally, the results of this research call for collaborative actions from educators and professional organisations to support the needs of ND students. These include interventions and capacity building curriculum activities to address the problems associated with disordered eating attitudes and behaviours and to facilitate a more balanced attitudes and behaviours. Continuous attention to these issues is critical for the well-being of student studying nutrition and dietetics, and for the sustainability of the profession of nutrition and dietetics for the future.
7.6 References


Appendices

Introduction to this section

This section of the thesis includes appendices referred to in Chapters 1 and 2 of the document. Appendices 1 – 4 includes conference presentations generated from this research. Appendix 5 provides additional results not included in the main body of this document. Appendix 6 includes an article entitled: “Nutrition knowledge of dietetic undergraduate students: An exploratory study” published in Nutrition & Dietetics. The article is co-authored by the author and is based on data collected during Stage 1 of this research. Appendices 7 – 14 provide copies of the questionnaires used in the data collection. Finally, Appendix 15 includes additional illustration of results not included in the main body of this thesis.

Reference

Abstract
There is currently little known about the eating and exercise practices of students studying nutrition and dietetics and how these differ across years of study and in comparison to similar female dominated disciplines. Therefore, the aim of this study was to investigate the dietary intake and physical activity (PA) of undergraduate students enrolled in nutrition and dietetics (ND) discipline, and compare to a cohort of students enrolled in occupational therapy (OT). The Dietary Questionnaire for Epidemiological Studies (Cancer Council Victoria) and the International Physical Activity Questionnaire were used to explore food and nutrient intake, and PA level respectively. Data were collected between August-October 2013 as part of a broader research investigating eating behaviours, body image, and body composition of this cohort. Overall, 147 students including 97 ND and 50 OT students participated in this study. Preliminary data analysis suggests a variety of dietary regimens and preferences across both cohorts. The mean energy intake for ND cohort was 6,389.2 ± 2,976.9 kJ/day, with 40% of energy obtained from carbohydrates, 22% from protein and 38% from fat. The majority of participated ND students (86%) engaged in vigorous or moderate PA, with over 78% completing these forms of exercise for at least 150 minutes per week. The association between eating behaviours and psychological and physiological characteristics of this population will also be presented. The results of this study will enhance educators understanding of the background dietary habits and exercise behaviours of nutrition and dietetics students.
Appendices

Poster presentation

Reference

Abstract
Eating attitudes and behaviours of female students enrolled in the discipline of nutrition and dietetics (ND) in Australia has not been previously explored. Therefore, the aim of this study was to examine these characteristics in undergraduate ND students in comparison to a group of female students enrolled in occupational therapy (OT). A cross-sectional data collection was initiated in August-October 2013 as part of longitudinal research investigating dietary and exercise behaviours and practices, plus body composition of this cohort. Previously validated questionnaires, including the Eating Attitudes Test, the Three-Factor Eating Questionnaire, the Rosenberg Self-Esteem Scale, and the Body Shape Questionnaire were administered to students to assess eating behaviours, self-esteem and body dissatisfaction respectively. Overall, 119 females students (75 ND and 44 OT) participated in this part of the study. Preliminary results suggest no significant differences in eating behaviours, self-esteem and body dissatisfaction between student populations. However, almost two thirds of the participants have indicated mild to marked concern with body shape despite the mean reported Body Mass Index of 23.1 kg/m2. The associations between eating attitudes and demographic, physiological and psychological characteristics of this sample will be presented. Implications for future studies in this population will be discussed.
Poster presentation

Eating attitudes and behaviours in a sample of female university students: does studying nutrition and dietetics make a difference?

Tetyana Rocks, Fiona Pelly, Gary Slater, Lisa Martin

School of Health and Sport Sciences, University of the Sunshine Coast, QLD, Australia

**Aim**
To examine eating attitudes and behaviours in a sample of female undergraduate Nutrition and Dietetics (ND) students in comparison to a similar group of students enrolled in Occupational Therapy (OT).

**Introduction**
Eating attitudes comprise of thoughts, feelings and beliefs that shape the relationship an individual has with food. They are greatly affected by personal histories, perceptions, knowledge and environment and, in turn, shape eating preferences and behaviour. Maladaptive eating attitudes may form when a complex relationship with food is driven by feelings of guilt, negative social comparison, low self-esteem and poor body image.

**Methods**
A cross-sectional survey was initiated in August-October 2013 as part of a longitudinal research investigating eating attitudes and behaviours of ND students. A range of demographic characteristics were collected via an additional questionnaire. The eating attitudes, self-esteem and body shape satisfaction were assessed via the following:
1. The eating attitudes test
2. The Three-Factor Eating Questionnaire
3. The Rosenberg Self-Esteem Scale
4. The Body Shape Questionnaire

The study was approved by the University of the Sunshine Coast Human Ethics Committee.

**Results**
- Participation: 119 females (n=119 ND, n=44 OT)
- Median age: 23.5 (range 17-61)
- No significant difference in median Body Mass Index (BMI) measured (p>0.05)
- Significantly lower perceived ideal BMI for both groups (Table 1)

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>ND group</th>
<th>OT group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ND group</td>
<td>19.0±2.5</td>
<td>22.0±3.0</td>
<td>20.5±2.0</td>
</tr>
<tr>
<td>OT group</td>
<td>18.3±2.3</td>
<td>22.0±3.0</td>
<td>20.5±2.0</td>
</tr>
<tr>
<td>Total</td>
<td>19.0±2.5</td>
<td>22.0±3.0</td>
<td>20.5±2.0</td>
</tr>
</tbody>
</table>

- No significant correlation between degree of involvement and eating attitudes scores (Table 2)
- Out of 17 individuals that scored as ‘at-risk’ developing an eating disorder, 12/17 were from ND and 5/44 were from OT (Figure 1)

**Discussion**
In our study, eating attitudes and behaviours did not vary depending on the discipline of enrolment with the exception of negative restraint, which was higher in ND group. Additionally, no correlations were found between eating attitude and age, BMI or perceived ideal BMI of participants. However, in all participants maladaptive eating attitudes was positively correlated with uncontrolled eating, cognitive restraint, emotional eating and increased body shape concern, and negatively correlated with self-esteem.

**Future Focus**
- To establish whether relationships exist between eating attitudes and dietary and exercise practices in this cohort
- To determine longitudinal changes in eating attitudes and its correlates.
Appendices

Appendix 3: Abstract and poster presentation for the Australia and New Zealand Academy for Eating Disorders (ANZAED) 14th Annual Conference: Riding the Waves of Recovery, Gold Coast Australia, 21-22 August 2015.

Reference

Abstract
It remains unclear if studying a health-related degree alters an individual's eating attitudes and diet-related behaviours. This study explored changes in eating attitudes and behaviours in 36 female students (mean age 28.6 ± 10.0 years) enrolled in health degrees (nutrition and dietetics, n = 26; occupational therapy, n = 10) over a year of their undergraduate studies. Participants were asked to complete several self-reported questionnaires, including the Eating Attitudes Test (EAT-26), the Three-Factor Eating Questionnaire (TFEQ-R18), the Rosenberg Self-Esteem Scale, and the Body Shape Questionnaire (BSQ-8D) that assessed their demographic, anthropometric, dietary, body satisfaction and self-esteem related characteristics in September-October 2013 and again 12 months later. Results suggest a significant decrease in eating disorder risk and body dissatisfaction, with an increase in self-esteem. However, the participants' weight, cognitive restraint, uncontrolled eating and emotional eating remained stable. The associations between the explored characteristics will be presented on a group and individual level. Possible directions for future research in this population will be outlined.
Appendices

Poster presentation

Changes in eating attitudes and behaviours in a sample of female university students studying health degrees: a 12-months follow-up study.

Tetyana Rocks, Fiona Polly, Gary Slater, Lisa Martin
School of Health and Sport Sciences, University of the Sunshine Coast, QLD, Australia

Introduction

Disordered eating attitudes and behaviours and body image dissatisfaction are prevalent in university female students. However, it remains unclear if they are more prevalent among those who have studied health-related degrees.

Methods

Data was collected at two points:
- Time 1: Semester 2, August-October 2011.
- Time 2: Semester 2, August-October 2012.

A questionnaire was used to capture the demographic characteristics of the participants and their eating attitudes and behaviours. The validated scales used were as follows:
- The Eating Attitude Test 40
- The Three-factor Eating Questionnaire
- The Body Image Evaluation Questionnaire

To ensure individual changes were not due to re-administration, only participants who completed both Time 1 and Time 2 were included in the analyses.

The study was approved by the University of the Sunshine Coast Human Research Ethics Committee.

Results

- Participation: n=115 students (n=53 ND, n=62 OT).
- Mean age: 21.8 years old (range 19 - 46)
- Body mass index (BMI):
  - At Time 1: 18.6 kg/m²
  - At Time 2: 19.1 kg/m²
- EDI scores:
  - At Time 1: 5.6 (normative)
  - At Time 2: 5.0 (normative)

- Eating attitudes:
  - Increase in disordered eating scores from 12.3 ± 4.0 to 13.0 ± 3.6 (p=0.05 (Figure 1))

- Body shape satisfaction:
  - Decreased in disordered eating scores from 50.7 ± 10.5 to 50.3 ± 10.5 (p=0.05 (Figure 2))

Discussion

- Results suggested an overall increase in self-esteem and decrease in disordered eating attitudes and body image dissatisfaction at Time 2 compared to Time 1.
- An individual level, strong correlations between BMI, self-esteem and body shape satisfaction were identified.

Further focus

- To explore demographic characteristics that relate to positive changes in eating attitudes and behaviours and body image dissatisfaction.
- To examine whether individual changes in eating attitudes and behaviours correlate with changes in diet and exercise.

Figure 1: Changes in disordered eating attitudes and body image dissatisfaction between Time 1 and Time 2 (p<0.05 (Figure 2)).
Appendix 4: Abstract and poster presentation for the International Confederation of Dietetic Association 17th International Congress of Dietetics, 7-10 September 2016.

Reference

Abstract
Educators and professional bodies have previously expressed concerns about the issue of maladaptive behaviours, such as disordered eating, in individuals studying nutrition and dietetics. Another maladaptive behaviour that have been previously linked to disordered eating is exercise addiction, which have not been previously investigated in this population. Therefore, the aim of this research was to examine the prevalence of self-reported symptoms of exercise addiction in a sample of nutrition and dietetics (ND) students, and to explore correlations between exercise addiction, disordered eating attitudes and cognitive restraint, in this sample. A total of 147 student volunteers (97 ND; 50 controls) completed four validated tools for assessment of exercise- and eating-related attitudes and behaviours: the Exercise Addiction Inventory (EAI), the International Physical Activity Questionnaire, the Eating Attitudes Test-26, and the Three Factor Eating Questionnaire-R18. Approximately 23% of ND students scored as at-risk of been addicted to exercise, whilst 95% demonstrated some symptoms of exercise addiction. The EAI scores did not vary between genders ($P = 0.058$), albeit male ND participants reported greater amounts of exercise than females ($P = 0.006$). In females, the scores for exercise addiction correlated with the amount of exercise ($r_s = 0.43, P < 0.00$), disordered eating attitudes ($r_s = 0.31, P = 0.006$), and cognitive restraint ($r_s = 0.31, P = 0.007$). Results of this study revealed a high prevalence of exercise addiction symptomology and correlation to maladaptive eating attitudes in ND students. These findings will be of interest to teaching and professional bodies involved with educating this population. Support programs devised to prevent and manage disordered behaviours, should not overlook the issue of exercise addiction.
Appendices

Poster presentation

Exercise Addiction and the Relationship to Disordered Eating Attitudes in a Sample of Australian Nutrition and Dietetics Students
Tetyana Rocks, Fiona Pelly, Gary Slater, Lisa Martin
School of Health and Sport Sciences, University of the Sunshine Coast, Australia

Introduction: Previous research has shown a concerning prevalence of disordered eating in undergraduate students studying nutrition and dietetics (ND). However, little is known about the occurrence of exercise addiction (EA), which has previously been linked to eating psychopathology in this population. EA is an obsessive preoccupation with exercise, maintenance of exercise despite injury, fatigue or illness, and interference of exercise with personal, social or professional life. EA is maladaptive behaviour and could result in physical, psychological and emotional impairment.

Aim: To examine the prevalence of self-reported symptoms of EA in a sample of ND students, and to explore correlations between EA, disordered eating attitudes and cognitive restraint in this sample.

Methods: Volunteers (97 ND, 65 occupational therapy students) completed four questionnaires in August-October 2013, including: the Exercise Addiction Inventory, the International Physical Activity Questionnaire, the Three-Factor Eating Questionnaire, and the Rating Attitudes Test.

Results: Participants included 69 female, 17 male in ND group and 48 female, 2 male in OT group. Mean age of students was 27.0 ± 8.7 years.

- 23% ND scored as at high risk of EA (20% female and 36% male, \( P = 0.21 \))
- 7% ND scored as symptomatic (72% female and 0% male, \( P = 0.05 \)) in ND females, but not in males, EA correlated with
  - volume of physical activity, \( R = 0.42, P < 0.001 \)
  - cognitive restraint, \( R = 0.31, P = 0.007 \)
  - disordered eating attitudes, \( R = 0.31, P = 0.005 \) (Figure 1)

Discussion: There was a high prevalence of EA symptomology in ND students. Additionally, in females EA symptomology correlated with eating psychopathology. This may suggest the primary nature of EA in males and secondary to cognitive restraint and eating disordered symptomology nature of EA in females.

Educators and professional bodies involved with training nutrition and dietetics students should devise measures to prevent and ethically manage EA in this population.

Appendix 5: The Dietary Questionnaire for Epidemiological Studies v2

Reference

Acknowledgement
The authors thank Professor Graham Giles of the Cancer Epidemiology Centre, Cancer Council Victoria, for permission to use the Dietary Questionnaire for Epidemiological Studies (Version 2), Melbourne: Cancer Council Victoria, 1996.

Clarification
Accurate assessment of habitual dietary intake is a challenging process.\textsuperscript{1-3} A food frequency questionnaire (FFQ) is a quick, low participant burden tool that allows to estimate a typical food consumption pattern over a set period of time.\textsuperscript{1,2} Furthermore, combined with another method of dietary assessment, such as a series of 24-hour dietary recalls, a FFQ has been shown to improve the assessment of dietary intake, including intake of macronutrients.\textsuperscript{1}

There is a limited number of FFQs that could be used in Australian population. The FFQ used by this project is a short-form of the questionnaire developed in 1980’s by Cancer Council Victoria. Initial form of the questionnaire consisting of 121 items was validated in 810 ethnically diverse middle age men and women volunteers.\textsuperscript{4} More recently, the FFQ was modified into a shorter, 74 item questionnaire, the Dietary Questionnaire for Epidemiological Studies (DQESv2). The DQESv2 was validated for the preceding 12 months against 7-day weighed food records in 63 women (mean age 33 ± 9 years old),\textsuperscript{5} and for the preceding 1 month against 3-day weighed food records in 53 males and 65 females age 20 – 75 years old.\textsuperscript{6} As the data collection for this project was initiated, Hebden and colleagues (2013)\textsuperscript{7} published the results of the study that assessed the relative validity and reproducibility of the DQESv2 over the preceding 1 months against 5-day weighed records in 102 men and women age 18 – 35 years old. In all of these studies the differences in nutrient and food intakes between methods were within ± 20\%. Although some shortcomings of the DQESv2 were noted, in particular the lack of assessment of
foods commonly consumed by a younger population, for example berries, eggplant or alcohol, the DQESv2 was suggested as a valid tool to measure energy, protein, fats, carbohydrates, sugars and dietary fibre in a younger population.

In this research, preliminary results of the dietary assessment conducted by the DQESv2 were presented at the 31st National Conference of the Dietitians Association of Australia (please refer to Appendix 1). The mean energy intake for ND cohort estimated by the DQESv2 approximated 9450 kJ.day\(^{-1}\) (2250 kcal.day\(^{-1}\)) for males, and 5750 kJ.day\(^{-1}\) (1370 kcal.day\(^{-1}\)) for females. In 36% of males and 54% of females this energy consumption was below the resting metabolic rate estimated using the Schofield equation. Due to this, the results obtained by the DQESv2 were not used to support estimation of energy status.

References


Appendix 6: Related publication not included in the body of the thesis

This appendix presents results from Stage 1 data collection. The appendix consists of a paper published in the journal *Nutrition & Dietetics* (please see full reference below). The paper explores nutrition knowledge in students studying nutrition and dietetics, nutrition and occupational therapy degree and compares the groups. This paper was a part of honours work supervised by the author of this thesis.

This is the peer reviewed version of the following article:

**Authors declaration**
All authors were responsible for the design of study. TR and KL collected the data. KL analysed the data, KL and FP interpreted the data and KL wrote the paper with contribution and editing by FP. All authors reviewed and approved the final manuscript.
Nutrition knowledge of dietetic undergraduate students: An exploratory study

Abstract

Aim: To describe the level of nutrition knowledge in students undertaking an accredited nutrition and dietetics (ND) undergraduate program in reference to students enrolled in non-accredited nutrition or non-nutrition allied health programs. The secondary aim was to investigate the variation in nutrition knowledge of ND students.

Methods: Students enrolled in ND, nutrition (NUT) or occupational therapy (OT) undergraduate programs at an Australian university were invited to participate in an online survey in August 2013. Nutrition knowledge levels were measured using the validated Re-examined General Nutrition Knowledge Questionnaire (R-GNKQ). Socio-demographic characteristics and sources of nutrition information were also collected.

Results: Students in the first year of ND or NUT programs had significantly higher overall scores than the OT students ($P = 0.046$ and $P = 0.005$, respectively). Substantially greater overall scores were observed for the students in the second year of the ND program than those in the first year ($P = 0.01$). The highest level of nutrition knowledge was observed in third year ND students. Overall score for ND students was influenced by year level and previous education, but not by gender, age, living situation or ethnicity.

Conclusions: ND students entered the program with high nutrition knowledge levels. The dietetic program appeared to develop the general nutrition knowledge of students to a level comparable to practising dietitians. Research investigating underlying knowledge development is necessary to direct dietetic curriculum design and delivery.

Key words: Australia; education; nutrition knowledge; student dietitians.

Introduction

The dietetic profession has recently experienced exponential growth in the number of students commencing ND programs,\(^1\) which is a result of the increasing number of professionally accredited university degrees throughout Australia. A total of 694 students
commenced Australian dietetic programs in 2012, which is a 62% increase since 2007.\(^1\) This is likely a reflection of the universities drive to match the heightened public interest in health and nutrition as well as the high student demand for study in this area. There are currently 22 undergraduate and postgraduate programs available at Australian universities, of which 18 are accredited with the remaining four undergoing accreditation processes.\(^2\)

The educational institutions that offer accredited ND programs are responsible for delivering new-graduate dietitians with sufficient knowledge, skills and attitudes required for safe and effective practice in the current working environment.\(^3,4\) The underlying knowledge of human nutrition and food science is fundamental for attaining these skills as well as professional competencies across the diverse areas of dietetic practice.\(^3,5\) Therefore, fundamental nutrition knowledge, which is developed through an evidence-based approach, should ideally be the primary focus of early ND curriculum, particularly in undergraduate programs.\(^6\)

However, nutrition knowledge is not solely dependent on formal education. Personal beliefs about nutrition may not be based on evidence, but rather originate from secular thinking about food and nutrition.\(^7\) Today, there are numerous information media readily accessible, many of which are non-credible and promote controversial and inaccurate messages about nutrition.\(^8\) University students in various disciplines have been shown to commonly use potentially inaccurate sources of nutrition information such as the internet, media and family and friends.\(^9,10\) This is of concern as the media is the main source of nutrition misinformation identified in the general public.\(^11,12\) Although it is the aim of dietetic education to train students to employ an evidence-based approach when accessing sources of information for self-directed learning and evaluation,\(^5\) it remains unknown whether nutrition misinformation is an issue among dietetic students.

Pre-existing knowledge and beliefs influence how individuals interpret and accept new information, and thus preconceived ideas dietetic students have about food and nutrition could influence their learning journey.\(^13\) Previous studies on this topic have consistently shown that individuals entering ND programs have a range of previous experiences with
food, health and nutrition\textsuperscript{14-17} that contributes to their personal understanding.\textsuperscript{17,18} In addition, nutrition knowledge in community samples has been found to be influenced by age, gender, education and socio-economic status, with educated females having the highest nutrition knowledge.\textsuperscript{11,19} As ND students are predominately female\textsuperscript{20} and many have previous undergraduate training,\textsuperscript{16} it is conceivable that they enter dietetic programs with pre-existing nutrition knowledge. Understanding the progression of underlying knowledge of ND students throughout the program would enable curriculum scaffolding to be refined to assimilate the application of professional knowledge and skills.

Currently there is an absence of literature that has evaluated the nutrition knowledge of students undertaking dietetic programs in Australia. The present research aims to describe the level of general nutrition knowledge in students enrolled in an accredited undergraduate ND program in reference to a non-accredited NUT and an accredited OT program, and compare knowledge status across the year levels of study. The secondary objective was to investigate the variation in knowledge among the ND cohort according to socio-demographic characteristics, sources of nutrition information and reported dietary behaviours.

**Methods**

Students enrolled in ND (four year professionally accredited), NUT (three year non-accredited) or OT (four year professionally accredited) undergraduate programs at an Australian University were eligible to participate in this cross-sectional study. All participants were invited to complete an online survey during July and August 2013. This time period was chosen as it represented the start of the second semester and students in their first year of study had not completed any nutrition courses to date. The OT students were selected as a comparator with similar demographic characteristics (age and gender) to those undertaking nutrition training. The protocol for the research project was approved by the University’s Human Research Ethics Committee (HREC no. S/13/525).

Nutrition knowledge was measured using the re-examined and validated version of the General Nutrition Knowledge Questionnaire (GNKQ),\textsuperscript{21} referred to as the R-GNKQ.\textsuperscript{22} This questionnaire covers four areas of nutrition knowledge: dietary recommendations
(section A, 11 items), sources of nutrients (section B, 62 items), choosing everyday foods (section C, five items), and diet–disease relationship (section D, 18 items). Different types of question styles were used including multiple choice, true or false and open-ended. As previously defined,21-23 correct responses for each item were given a score of one and added to give a section score, which were subsequently totalled to give a score of the overall nutrition knowledge (out of 96). Higher scores reflect a higher level of nutrition knowledge.

Relevant socio-demographic questions were included in the survey to collect a general description of the respondents (e.g., age, gender and previous education) as well as of the university enrolment (e.g., program and year level of current courses). Questions regarding information on nutrition background were designed by the research team informed by relevant literature and research experience. This section included eight items regarding nutrition information sources, dietary regimens and exclusion of foods. The demographic questions were piloted with a sample (n = 10) of university students who did not participate in the final study. Minor changes were made by the researchers to improve face content validity, feasibility and questionnaire design layout.

Data were coded numerically, entered and analysed using the Statistical Package for Social Sciences Statistical Software version 21.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to describe the socio-demographic and nutrition-related information of respondents. Between group differences were assessed with one-way ANOVA (continuous variables) and independent group chi-squared tests or Fisher’s tests (categorical variables). Independent t-test or one-way ANOVA was used to assess mean nutrition knowledge scores differences. The Shapiro-Wilk test was performed to assess normality; either the Kruskal-Willis or Mann-Whitney U-tests were applied to non-normally distributed data. Multiple regression analyses were conducted to explain the variation in nutrition knowledge. Significance was set at $P < 0.05$, with the exception for multiple comparisons between groups, for which the Bonferroni correction was applied.
**Results**

A total of 167 students responded to the survey; however, two respondents were excluded because of not meeting eligibility criteria and incomplete responses. The 165 left for analysis represented 47% ND, 28% NUT and 21% OT of the students enrolled in 2013. The majority of student participants across all programs were female (87.3%), Caucasian (98.2%) and under 25 years of age (60.0%). This sample was representative of the cohort of students enrolled in these degrees, who were predominately (female (85.5%), less than 20 years of age (43.0%). Although no figures were available to support the ethnic diversity, this is representative of health degrees at the university. There was a significantly greater proportion of males in NUT than OT ($P = 0.04$; Table 1). The NUT cohort had significantly fewer respondents in their second and third year of study than ND and OT ($P < 0.001$). Because of the poor representation of students enrolled in the second and third year of the NUT program, these groups were removed for analysis. There were no other significant differences between disciplines.

The ND cohort was considered uniform with no significant differences in demographic characteristics across year levels. The majority of students (75.2%) chose to study one of the two nutrition programs because of personal interest in food and/or nutrition. Almost all students in both nutrition programs resided with others and were responsible for their food shopping and preparation (Table 1). Many students reported following a particular dietary regimen (36.7%), of which were mostly self-prescribed (72.5%; Table 1). Significantly more first year students (58.0%) reported to be following a dietary regimen than students in second year (36.0%) and third/fourth year (15.2%; $\chi^2 = 15.04; P = 0.001$). Avoiding types of foods (e.g., processed food), food groups (e.g., red meats) or components of food (e.g., wheat/gluten), was also commonly reported among ND students (54.1%).

The mean overall R-GNKQ scores were compared according to year level of study for each of the three disciplines (Figure 1). The overall scores for students in their first year of study differed significantly across disciplines (H (2,52) = 13.84; $P = 0.001$; Figure 1). The OT discipline had a significantly lower overall score than the NUT ($P = 0.046$) and ND ($P = 0.005$) disciplines. The diet-disease relationship (section D) was the only section
to be significantly different between students commencing both nutrition programs and students commencing OT ($H(2,52) = 13.84; P = 0.001$). There were no significant differences in overall scores between the NUT and ND groups in the first year of study (Figure 1).

Table 1. Respondent demographic and nutrition-related characteristics according to university degree program.

<table>
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<th>Nutrition</th>
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<th>OT</th>
<th>$P^*$</th>
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</tr>
<tr>
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<td>53(94.6)</td>
<td>0.04*a</td>
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<td>1 (1.3)</td>
<td>1 (1.8)</td>
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<td>(17.0-37.6)</td>
<td>(17.5-36.3)</td>
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<td>Age (years)</td>
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<tr>
<td>Mean±SD</td>
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<td>26.7±8.5</td>
<td>25.2±8.6</td>
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Appendices

### Previous academic experience

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### Responsible for the cooking and shopping

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### Currently following a dietary regimen

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<tr>
<td></td>
<td>11(19.6)</td>
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<table>
<thead>
<tr>
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<td>56(100)</td>
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</table>

*Significant difference between nutrition and OT groups; \(^{b}\)The nutrition group had significantly fewer respondents in the second and third year of study than the ND and OT groups \((P < 0.001)\); There were no significant differences between ND and OT \((P = 0.45)\); \(^{*}\)Significant at \(P < 0.05\); NA, not applicable; ND, nutrition and dietetics; OT, occupational therapy.

---

![Figure 1](image-url)

**Figure 1.** Overall knowledge score (mean ± SD) according to discipline and year level \((n = 156)\). Respondents enrolled in the second and third year of the nutrition program \((NUT)\) were excluded because of the small sample size. \(^{*}\)Indicates significant difference between...
disciplines ($P < 0.02$). *Indicates significant difference between year levels within the nutrition and dietetics (ND) cohort ($P < 0.01$).

The mean overall scores differed significantly between the year levels in the ND program ($H (3, 76) = 38.92; P < 0.001$), but this was not the case in the OT program (Figure 1). Within the ND discipline alone, the greatest difference in overall score was between first and second year levels, where the mean score for second years was 12.5% higher than the first years ($P < 0.001$; Figure 1). As there were no significant variations in overall knowledge scores between the fourth and third year levels, the two groups were combined for the following analyses.

Across all four year levels of the ND program, the average sections scores were the highest for choosing everyday foods (section C) and lowest for diet-disease relationship (section D; Table 2). The year levels differed significantly on all sections (A: $H (2, 76) = 9.72, P = 0.01$; B: $H (2, 76) = 37.88, P < 0.001$; D: $H (2, 76) = 19.02, P < 0.001$) except choosing everyday foods ($H (2, 76) = 5.91, P = 0.052$; Table 2). When compared to the first year cohort, the second year students scored substantially and significantly better in knowledge of dietary recommendations (section A; mean difference 12.2%; $P = 0.022$) and sources of nutrients (section B; mean difference 13.5%; $P = 0.005$; Table 2). The third and fourth year cohort had a significantly greater score for sources of nutrients (section B) than the first year (mean difference 19.8%; $P < 0.001$) and second year (mean difference 6.3%; $P < 0.001$; Table 2). The diet-disease relationship (section D) score was only significantly greater in the third and fourth year cohort in comparison to the first year cohort (mean difference 21.2%; $P < 0.001$; Table 2).

The utilisation of credible and less credible sources of information significantly differed between ND students in first year to the students in later year levels ($F (2, 76) = 31.48; P < 0.01$; Figure 2). Students in the first year relied on less credible information sources including the Internet, books, media, family and friends. Conversely, students in the second year primarily referred to course materials and scientific literature (Figure 2).
The variation in nutrition knowledge according to independent predictors was investigated through multiple linear regression analyses. Suspected socio-demographic influencers on knowledge (education, employment, gender, age and living situation) and degree program were entered into a model for first year students. A separate model for the ND sample included suspected characteristics of socio-demographics, year level of study, primary nutrition information source and dietary behaviours. Results showed that previous academic experience and degree program were the only variables to have significant effects on nutrition knowledge among first year students ($R^2 = 0.23$, $F(2, 51) = 7.49$, $P = 0.001$). Year level and highest education had significant effects on nutrition knowledge in the ND cohort ($R^2 = 0.53$, $F(2,76) = 41.62$, $P < 0.001$), with year level of study explaining 49% of variation ($P < 0.001$).
Table 2. Overall and section scores on the Re-examined General Nutrition Knowledge Questionnaire (R-GNKQ) for students enrolled in nutrition (NUT) or nutrition and dietetics (ND) program presented as mean ± SD, range and percent accuracy.

<table>
<thead>
<tr>
<th>Section (max points)</th>
<th>First year (n=19)</th>
<th>Second year (n=25)</th>
<th>Third &amp; fourth year (n=33)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SD</td>
<td>Range</td>
<td>%</td>
<td>Mean±SD</td>
</tr>
<tr>
<td>A: Dietary recommendations (11)</td>
<td>8.4±2.0</td>
<td>4-11</td>
<td>76.5</td>
<td>9.8±2.0</td>
</tr>
<tr>
<td>B: Sources of nutrients (62)</td>
<td>44.3±6.8</td>
<td>31-58</td>
<td>71.5</td>
<td>52.7±4.0</td>
</tr>
<tr>
<td>C: Choosing everyday foods (5)</td>
<td>4.4±0.5</td>
<td>3-5</td>
<td>87.4</td>
<td>4.7±0.5</td>
</tr>
<tr>
<td>D: Diet-disease relationship (18)</td>
<td>11.1±3.3</td>
<td>4-16</td>
<td>61.7</td>
<td>13.0±3.1</td>
</tr>
<tr>
<td>Overall score (96)</td>
<td>68.2±10.1</td>
<td>52-85</td>
<td>71.1</td>
<td>80.2±6.0</td>
</tr>
</tbody>
</table>

*aThe second year cohort had significantly greater score than the first year cohort; bThe mean scores were significantly different between all year levels; cThe third and fourth year cohort had a significantly greater score than the first year cohort; *Significant set at $P < 0.01$ to account for multiple comparisons.
Discussion

This study evaluated the general nutrition knowledge of students enrolled in a professionally accredited undergraduate ND program and compared scores with students from a non-accredited NUT and an OT program. Students in the first year of ND and NUT programs had substantially better overall and diet-disease relationship scores than first year OT students. Knowledge regarding public health recommendations, sources of nutrients and healthy food choices were similar between first year students in both nutrition programs to the cohort of OT students. All three disciplines answered the sections on public health recommendations and sources of nutrients with around 70% accuracy, which is slightly higher than findings from Australian community samples tested with the GNKQ (62–69%).\textsuperscript{11,22,23} Other research in community\textsuperscript{11} and athlete\textsuperscript{22} populations reported that the diet–disease relationship was poorly understood, with section scores below 50%. In contrast, first year students in both nutrition programs had an average score above 60%, demonstrating a degree of knowledge regarding the links between nutrients, food sources and disease.

As expected, the overall nutrition knowledge scores were significantly greater among students in the later years of the ND program; however, the fourth year cohort had similar scores to those in the third year. Year level was the strongest predictor of nutrition knowledge in ND students, accounting for 49% of variation. The differences were most apparent in knowledge about sources of nutrients and the diet-disease relationship. The largest difference in nutrition knowledge was observed between the students in first and second year of the ND program. This corresponds to the introductory nutrition subjects completed by those enrolled in the second year. Third year students had an overall nutrition knowledge score that was 6% greater than second year students, reflecting knowledge is further refined after completion of advanced nutrition courses.

Nonetheless, nutrition misinformation was evident among students undertaking ND programs. The written responses on the diet-disease relationship revealed confusion across all year levels in regard to the diseases associated with poor fruit and vegetables and excess sugar consumption. Our findings reflected what has been previously reported for an Australian community sample, where respondents also believed sugar was linked
to diabetes mellitus and lacked knowledge on the effects of a low fruit and vegetable intake.\textsuperscript{11} Although third and fourth year students in our cohort were able to identify the correct diseases, many students still included other non-relevant diseases. Because of the R-GNKQ score allocation, the prevalence of misconceptions was not reflected in the knowledge scores. This may warrant further investigation to understand why students retain these beliefs despite improved general nutrition knowledge.

The secondary objective of the present study was to investigate the association between knowledge and other socio-demographical characteristics of the student cohort. In the present study, highest education was a predictor of nutrition knowledge in all cohorts, but gender and age had no effect in ND students. As education increases an individual’s ability to process nutrition information, understand complex concepts and internalise it for future recall,\textsuperscript{19} students with previous higher education may have had a greater capacity to develop underlying knowledge than their less educated peers. This has implications for the development of curriculum that accommodate the needs of student cohorts with varying educational backgrounds. It is interesting to note that by the completion of program, the mean overall knowledge score was similar to that of nutrition experts,\textsuperscript{22,24} and lowest scores were higher than community samples.\textsuperscript{11} This suggests that regardless of educational background students can attain a level of general nutrition knowledge on par to qualified dietitians near the completion of the ND program.

Higher nutrition knowledge scores in our study could be explained by the unique characteristics of dietetic students. The sample in the present study, as per majority of other studies evaluating nutrition knowledge,\textsuperscript{11,22,24} was predominately female. However, our sample is representative of both the student cohort and workforce of ND\textsuperscript{1,16} and OT.\textsuperscript{25} Females have been shown to be more interested in food and nutrition than males, which lead to the pursuit of nutrition-related information and activities.\textsuperscript{26} Furthermore, a student’s food and nutrition-related activities plays an important function in the transformation from a novice into a professional dietitian.\textsuperscript{17,18} Consistent with previous research,\textsuperscript{14,16-20} the ND students in the present study reported having a primary interest in food and nutrition, sought nutrition information and followed dietary regimens. In addition, the majority of students followed a regimen that involved elimination of certain food components on a self-prescribed basis as opposed to under the guidance of a
Appendices

qualified dietitian or due to a medical diagnosis. While following a dietary regimen was not significantly associated with nutrition knowledge, the proportion of individuals following regimens second year and beyond was significantly less than the first year students. It has been previously suggested that students studying nutrition from advanced years of study are less likely to engage in dietary restraint and have healthier food choices than those in earlier years.\(^{27}\) Furthermore, fourth year ND students have reported that an increase nutrition knowledge has had positive effects on their food choices.\(^{28}\) We cannot determine whether our findings are due to increased knowledge about the evidence behind specific regimens over the course of the degree or simply related to the characteristics of the year level or the particular study sample. Following students throughout their program of study would provide valuable information on changes in dietary practices in relation to improved knowledge.

The higher knowledge with degree progression may also be related to the sources of nutrition information used by students. Beyond first year, students utilise more credible sources of information and relied primarily on materials provided in ND courses. This reflects the introduction of critical appraisal of information sources during first and second year curricula. We did not investigate the reasons why students used specific types of information during their degree. However, an American study identified that dietetic students used course material over scientific literature because they found the information was better understood.\(^{10}\) Although dietetic curricula appear to effectively increase a student awareness of credible sources of information, it is unclear how confident dietetic students are in their ability to apply peer-reviewed research to inform decisions, for both personal food choices and when advising others.

It is likely that advancement in specific nutrition knowledge of students in the third and fourth year, such as that related to medical nutrition therapy, was not detected by the R-GNKQ. The R-GNKQ was not intended to determine levels of nutrition knowledge based on curriculum taught throughout a ND degree; rather, it was developed to quantify the general nutrition knowledge of the public in relation to healthy eating patterns and reducing risk of chronic disease. Furthermore, the final year of dietetic training includes practicum where students advance their knowledge and skills from a beginner to that of a competent entry-level dietitian.\(^{5}\) Therefore, assessing generic nutrition knowledge
using the R-GNKQ or similar is less relevant during the advanced stages of a dietetic program, where the focus should be assessment specific to application of skills and competency development.

There were a number of limitations to the present study. Although the demographic characteristics of participants were representative of ND and OT cohorts, there is limited generalizability to other educational settings and underrepresented groups (e.g., males and those from culturally diverse backgrounds). It is also conceivable that those who decided to complete the survey were interested in nutrition and potentially had greater knowledge, especially in the OT group. Furthermore, the present study focused on students enrolled in undergraduate programs and therefore may not apply to postgraduate training. The tool employed to evaluate nutrition knowledge was designed to measure the general knowledge assumed to be required for community members to follow healthful food behaviours. Thus, this research could not evaluate the application of professional knowledge, which has more relevance to assessing student competency towards the program completion. Lastly, because of the cross-sectional design, we could not determine the changes in each individual’s nutrition knowledge, information sources or dietary practices throughout the ND program.

In conclusion, students commenced ND programs with pre-existing general nutrition knowledge and by the third year of training attained a level of knowledge similar to practising dietitians. This coincided with use of more credible sources of nutrition information and less likelihood of following specialised dietary regimens; however, further research is required to explore the individual change in all these factors over the course of the degree. An understanding of the nutrition knowledge of students undertaking studies in ND can allow educators to tailor curriculum design and delivery to address nutrition misconceptions and personal views at the commencement of their degree, and develop an early understanding of an evidenced-based approach to dietetic practice.
Funding
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Conflicts of Interest
There were no conflicts of interest.

References


Appendix 7: The Eating Attitudes Test – 26

Reference

Test
Please fill out the form below as accurately, honestly and completely as possible. There are no right or wrong answers. All of your responses are confidential.

Part A. Complete the following questions:
1. Birth Date
2. Gender: Male Female
3. Height
4. Current Weight
5. Highest Weight (excluding pregnancy)
6. Lowest Adult Weight
7. Ideal Weight

Part B: Check a response for each of the following statements:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Always</th>
<th>Usually</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am terrified about being overweight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I avoid eating when I am hungry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find myself preoccupied with food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have gone on eating binges where I feel that I may not be able to stop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I cut my food into small pieces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I aware of the calorie content of foods that I eat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I particularly avoid food with a high carbohydrate content (i.e., bread, rice, potatoes, etc.)

<table>
<thead>
<tr>
<th>I feel that others would prefer if I ate more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I vomit after I have eaten</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I feel extremely guilty after eating</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I am occupied with a desire to be thinner</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I think about burning up calories when I exercise</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>Other people think that I am too thin</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I am preoccupied with the thought of having fat on my body</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I take longer than others to eat my meals</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I avoid foods with sugar in them</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I eat diet foods</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I feel that food controls my life</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I display self-control around food</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I feel that others pressure me to eat</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I give too much time and thought to food</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>I feel uncomfortable after eating sweets</td>
</tr>
<tr>
<td>Always</td>
</tr>
</tbody>
</table>
I engage in dieting behaviour
- Always
- Usually
- Often
- Sometimes
- Rarely
- Never

I like my stomach to be empty
- Always
- Usually
- Often
- Sometimes
- Rarely
- Never

I have the impulse to vomit after meals
- Always
- Usually
- Often
- Sometimes
- Rarely
- Never

I enjoy trying new rich foods
- Always
- Usually
- Often
- Sometimes
- Rarely
- Never

---

**Part C: Behavioural Questions. In the past 6 months have you:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gone on eating binges where you feel that you may not be able to stop?</strong></td>
<td>Never, Once a month, 2-3 times a month, Once a week, 2-6 times a week, Once a day or more</td>
</tr>
<tr>
<td><strong>A. Ever made yourself sick (vomited) to control your weight or shape?</strong></td>
<td>Never, Once a month, 2-3 times a month, Once a week, 2-6 times a week, Once a day or more</td>
</tr>
<tr>
<td><strong>B. Ever used laxatives, diet pills or diuretics (water pills) to control your weight or shape?</strong></td>
<td>Never, Once a month, 2-3 times a month, Once a week, 2-6 times a week, Once a day or more</td>
</tr>
<tr>
<td><strong>C. Exercised more than 60 minutes a day to lose or control your weight?</strong></td>
<td>Never, Once a month, 2-3 times a month, Once a week, 2-6 times a week, Once a day or more</td>
</tr>
<tr>
<td><strong>D. Lost 9-10 kg or more in the past 6 months</strong></td>
<td>Yes, No</td>
</tr>
<tr>
<td><strong>E. Have you ever been treated for an eating disorder?</strong></td>
<td>Yes, No</td>
</tr>
</tbody>
</table>

*Defined as eating much more than most people would under the same circumstances and feeling that eating is out of control.*
Appendix 8: The Three Factor Eating Questionnaire

Reference

Questionnaire
Please read and answer the following statements.

1. I deliberately take small helpings as a means of controlling my weight.
   - Definitely true
   - Mostly true
   - Mostly false
   - Definitely false

2. I consciously hold back at meals in order not to gain weight.
   - Definitely true
   - Mostly true
   - Mostly false
   - Definitely false

3. I do not eat some foods because they make me fat.
   - Definitely true
   - Mostly true
   - Mostly false
   - Definitely false

4. How frequently do you avoid “stoking up” on tempting foods?
   - Almost never
   - Seldom
   - Usually
   - Almost always

5. How likely are you to consciously eat less than you want?
   - Unlikely
   - Slightly likely
   - Moderately likely
   - Very likely

6. On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never “giving in”), what number would you give yourself?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8

7. When I smell a delicious food, I find it very difficult to keep from eating, even if I have just finished a meal.
   - Definitely true
   - Mostly true
   - Mostly false
   - Definitely false

8. Sometimes when I start eating, I just can’t seem to stop.
   - Definitely true
   - Mostly true
   - Mostly false
   - Definitely false

9. Being with someone who is eating often makes me hungry enough to eat also.
   - Definitely true
   - Mostly true
   - Mostly false
   - Definitely false

10. When I see a real delicacy, I often get so hungry that I have to eat right away.
    - Definitely true
    - Mostly true
    - Mostly false
    - Definitely false
11. I get so hungry that my stomach often seems like a bottomless pit.

Definitely true  mostly true  mostly false  definitely false

12. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.

Definitely true  mostly true  mostly false  definitely false

13. I am always hungry enough to eat at any time.

Definitely true  mostly true  mostly false  definitely false

14. How often do you feel hungry?

Only at meal times  sometimes between meals  often between meals  almost always

15. Do you go on eating binges though you are not hungry?

Never  rarely  sometimes  at least once a week

16. When I feel anxious, I find myself eating.

Definitely true  mostly true  mostly false  definitely false

17. When I feel blue, I often overeat.

Definitely true  mostly true  mostly false  definitely false

18. When I feel lonely, I console myself by eating.

Definitely true  mostly true  mostly false  definitely false
Appendix 9: The Orthorexia Questionnaire

**Reference**


**Questionnaire**

Please read and answer the following statements.

<table>
<thead>
<tr>
<th>1. When eating, do you pay attention to the calories of the food?</th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. When you go in a food shop do you feel confused?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>3. In the last 3 months, did the thought of food worry you?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>4. Are you eating choices conditioned by your worry about your health status?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>5. Is the taste of food more important than the quality when you evaluate food?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>6. Are you willing to spend more money to have healthier food?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>7. Does the thought about food worry you for more than three hours a day?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>8. Do you allow yourself any eating transgression?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>9. Do you think your mood affects your eating behaviour?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>10. Do you think that the conviction to eat only healthy food increases self-esteem?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>11. Do you think that eating healthy food changes your life-style (frequency of eating out, friends, etc.)?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td>12. Do you think that consuming healthy food may improve your appearance?</td>
<td>Always</td>
<td>Often</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
</tbody>
</table>
Clarification

Data collected by an orthorexia nervosa questionnaire, the ORTO-15, were not used in this project due to sub-optimal psychometric performance (Cronbach’s alpha < 0.4). Orthorexia nervosa is a relatively new type of eating disorder. Orthorexia is characterized by an obsessive preoccupation with eating healthy food and avoiding unhealthy food. Although orthorexia nervosa is far from being a commonly accepted diagnostic category, it has initiated some preliminary research which examines this proposal in more detail. Furthermore, the American Dietetic Association recognised the increase of this disorder in its 2011 position statement of treatment of eating disorders.

Previous studies has shown occurrence of orthorexia nervosa symptomology in nutrition and dietetic profession. For example, a survey of 283 Austrian dietitians found that a considerable portion (35%) showed some symptoms of this disorder, while 13% were considered orthorexic. In addition, dietitians showing signs of orthorexia nervosa more commonly reported the existence of a previous or concurrent eating disorder. The Austrian study utilised the 10-question Bratman Test for orthorexia. Another study of 392 Brazilian dietitians used a Portuguese version of the ORTO-15 (provided above). Similarly to this research, the Brazilian study reported a low reliability of the test (Cronbach’s alpha = 0.39) and recommended further analyses to increase the psychometric quality of the tool. Nevertheless, researchers stated that the sample demonstrated high tendency for orthorexic behaviour.
A low initial internal consistency of the ORTO-15 have been reported by at least one other study. A German study\(^7\) attempted to validate a translated German version of the ORTO-15 in a mixed-sample participants (n = 1029). The initial Cronbach’s alpha was 0.30. A series of modelling manipulations increased internal consistency to 0.67 (for a 9-item tool). However, the German study concluded that their initial psychometric evaluation suggested limited evidence of validity and reliability of the ORTO-15.\(^7\)

It would be interesting to continue exploring orthorexic behaviour in the population of nutrition and dietetics students. However, further validation of the current version of the ORTO-15 are needed to determine the optimal model of analysis.

**References**

Appendix 10: The Exercise Addiction Inventory

Reference

Inventory
Please read and answer the following statements:

1. Exercise is the most important thing in my life.
   - Strongly disagree
   - Disagree
   - Neither agree nor disagree
   - Agree
   - Strongly agree

2. Conflicts have arisen between me and my family and/or my partner about the amount of exercise I do.
   - Strongly disagree
   - Disagree
   - Neither agree nor disagree
   - Agree
   - Strongly agree

3. I use exercise as a way of changing my mood (e.g., to get a buzz, to escape etc.).
   - Strongly disagree
   - Disagree
   - Neither agree nor disagree
   - Agree
   - Strongly agree

4. Over time I have increased the amount of exercise I do in a day.
   - Strongly disagree
   - Disagree
   - Neither agree nor disagree
   - Agree
   - Strongly agree

5. If I have to miss an exercise session I feel moody and irritable.
   - Strongly disagree
   - Disagree
   - Neither agree nor disagree
   - Agree
   - Strongly agree

6. If I cut down the amount of exercise I do, and then start again, I always end up exercising as often as I did before.
   - Strongly disagree
   - Disagree
   - Neither agree nor disagree
   - Agree
   - Strongly agree
Appendix 11: The International Physical Activity Questionnaire

Reference
IPAQ. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) - Short Form and Long Forms. [Internet]. 2005 [cited June 2016]. Available from: www.ipaq.ki.se

Questionnaire
We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?
   _____ days per week
   □ No vigorous physical activities  ➔ Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?
   _____ hours per day
   _____ minutes per day
   □ Don’t know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.
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3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.
   _____ days per week
   [ ] No moderate physical activities  \(\overset{\rightarrow}{\text{Skip to question 5}}\)

4. How much time did you usually spend doing moderate physical activities on one of those days?
   _____ hours per day
   _____ minutes per day
   [ ] Don’t know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?
   _____ days per week
   [ ] No walking  \(\overset{\rightarrow}{\text{Skip to question 7}}\)

6. How much time did you usually spend walking on one of those days?
   _____ hours per day
   _____ minutes per day
   [ ] Don’t know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the last 7 days, how much time did you spend sitting on a week day?
   _____ hours per day
   _____ minutes per day
   [ ] Don’t know/Not sure
Appendix 12: The Body Satisfaction Questionnaire

Reference
Evans, C. Body Shape Questionnaire (BSQ) and its shortened forms. [Internet].2003. [Updated April 2011; cited March 2013]. Available from: psyctc.org/tools/bsq/

Questionnaire
We would like to know how you have been feeling about your appearance over the past 4 weeks Please read each question and circle the appropriate number to the right. Please answer all the questions.

1. Have you been so worried about your shape that you have been feeling you ought to diet?
   Never  Rarely  Sometimes  Often  Very often  Always
2. Have you noticed the shape of other women/men and felt that your own shape compared unfavorably?
   Never  Rarely  Sometimes  Often  Very often  Always
3. Has being naked, such as when taking a bath, made you feel fat?
   Never  Rarely  Sometimes  Often  Very often  Always
4. Have you not gone out to social occasions (e.g., parties) because you have felt bad about your shape?
   Never  Rarely  Sometimes  Often  Very often  Always
5. Have you worried about other people seeing rolls of fat around your waist or stomach?
   Never  Rarely  Sometimes  Often  Very often  Always
6. When in company have you worried about taking up too much room (e.g., sitting on a sofa, or a bus seat)?
   Never  Rarely  Sometimes  Often  Very often  Always
7. Have you pinched areas of your body to see how much fat there is?
   Never  Rarely  Sometimes  Often  Very often  Always
8. Have you avoided situations where people could see your body (e.g., communal changing rooms or swimming baths)?

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very often</th>
<th>Always</th>
</tr>
</thead>
</table>
Appendix 13: The Rosenberg Self-Esteem Scale

Reference

Scale
Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, click strongly agree. If you agree with the statement, click agree. If you disagree, click disagree. If you strongly disagree, click strongly disagree.

1. On the whole, I am satisfied with myself.
   Strongly agree    Agree    Disagree    Strongly disagree
2. At times, I think I am no good at all.
   Strongly agree    Agree    Disagree    Strongly disagree
3. I feel that I have a number of good qualities.
   Strongly agree    Agree    Disagree    Strongly disagree
4. I am able to do things as well as most other people.
   Strongly agree    Agree    Disagree    Strongly disagree
5. I feel I do not have much to be proud of.
   Strongly agree    Agree    Disagree    Strongly disagree
6. I certainly feel useless at times.
   Strongly agree    Agree    Disagree    Strongly disagree
7. I feel that I’m a person of worth, at least on an equal plane with others.
   Strongly agree    Agree    Disagree    Strongly disagree
8. I wish I could have more respect for myself.
   Strongly agree    Agree    Disagree    Strongly disagree
9. All in all, I am inclined to feel that I am a failure.
   Strongly agree    Agree    Disagree    Strongly disagree
10. I take a positive attitude toward myself.
    Strongly agree    Agree    Disagree    Strongly disagree
Appendix 14: Demographic questionnaire

The following questionnaire was specifically designed for this research and piloted in 10 university students.

1. What is your date of birth? __________
2. What is your gender?
   ☐ Male
   ☐ Female
3. What is your current height and weight?
   Height (cm) __________
   Current weight (kg) __________
4. What do you think/believe is your ideal weight? (kg) __________
5. What is your ethnic origin?
   ☐ White/Caucasian
   ☐ Indigenous/ Torres Strait Islander
   ☐ Asian
   ☐ Other, please specify ________________
6. What is your marital status?
   ☐ Single
   ☐ Married
   ☐ De-facto/living with partner
   ☐ Separated
   ☐ Divorced
   ☐ Widowed
7. Do you have any children under 18 years old living with you?
   ☐ No
   ☐ 1
   ☐ 2
   ☐ 3
   ☐ 4
   ☐ More than 4
8. What is your current employment status?
   ☐ Living alone
   ☐ Living with partner/ family
   ☐ Living with parents
   ☐ Living in a shared accommodation
9. What is the highest level of education you have completed?
   ☐ Did not complete high school (left before grade 12)
   ☐ High school or equivalent
   ☐ Technical or trade certificate
   ☐ Diploma/ certificate
   ☐ Bachelor degree, please specify ________________
   ☐ Post-graduate degree, please specify ________________
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⦾ Unemployed/Full time student
⦾ Working part time/casual
    Average hours/week ___________________
⦾ Working full time
10 What degree are you currently enrolled in?
⦾ Bachelor of Nutrition _ go to 11
⦾ Bachelor of Nutrition and Dietetics _ go to 11
⦾ Bachelor of Occupational Therapy _ go to 12
⦾ Other, please specify _
11 What year did you commence your current degree? __________
12 Are you currently enrolled part time or full time?
⦾ Part time
⦾ Full time
13 How many semesters of study have you completed in your current
degree?_________
14 What year level are the majority of courses you are currently completing?
⦾ 1st year
⦾ 2nd year
⦾ 3rd year
⦾ 4th year
15 What was your overall position (OP) or entry rank for the current degree?
⦾ OP__________
⦾ Rank__________
⦾ Not applicable
16 Please list your current grade point average (GPA)?
⦾ _______________
⦾ Unsure
17 Where do you get most of your nutrition/diet information? (Rank the top three
(3) sources from 1 to 3)
⦾ Local doctor
⦾ Sports doctor
⦾ Dietitian
⦾ Naturopath/herbalist
⦾ Personal trainer
⦾ Team trainer
⦾ Partner/spouse
⦾ Mother/Father/Family
⦾ Friends
⦾ Newspapers/Magazines/Fliers
⦾ TV
⦾ Books
⦾ Scientific research articles
⦾ Lectures/Classes
⦾ Internet
⦾ Other, please specify________________
18 Are you currently trying to lose weight?
⦾ No
19 Are you currently trying to gain weight?

◎ Yes
◎ No
◎ Yes

20 Are you currently trying to change your body shape? (please select the most applicable answer)

◎ No (go to question 21)
◎ Yes (please specify below)
If yes, please select as many as applicable:

◎ I am trying to increase muscle mass
◎ I am trying to decrease muscle mass
◎ I am trying to increase body fat
◎ I am trying to decrease body fat

21 Are you currently following a dietary regimen?

◎ No (go to question 20)
◎ Yes (please specify below)
(If yes) Is this dietary regimen (select as many as applicable):

◎ A diet prescribed by a dietitian professional
◎ A diet prescribed by a natural therapist (e.g., naturopath)
◎ A diet prescribed by other health professional/doctor
◎ Self-prescribed diet (e.g., vegetarian)
◎ A diet from a secondary source such as a book, magazine or internet (e.g., Atkins, Paleo)
◎ Other, please specify_________________

Are you currently excluding any foods or food groups from your diet?

22 ◎ No (go to question 21)
◎ Yes (please specify below)
If yes, please select as many as applicable:

◎ Red meat rarely (only once every couple of weeks), mainly chicken and fish
◎ No red meat diet (chicken and fish only)
◎ No red meat or chicken diet (fish only)
◎ Lacto-ovo vegetarian (no meat, chicken or fish)
◎ Lacto vegetarian (no meat, chicken, fish or eggs)
◎ No animal products (Vegan)
Allergens

◎ Gluten free
◎ Wheat free
◎ Nut free
◎ Low/no lactose
◎ Dairy free
◎ No additives
◎ Natural/organic (e.g., none-processed, macrobiotic)
◎ Other allergen, please specify_________________

23 Are you currently following any other diet?

◎ No (go to question 22)
◎ Yes (please specify below)
If yes, please select as many as applicable:
Religious
☐ Halal
☐ Kosher
Other
☐ Low energy/ kilojoule
☐ High protein
☐ Low fat
☐ High carbohydrate
☐ Low carbohydrate
☐ High fibre
☐ Low sodium
☐ Low glycaemic index
☐ Other, please specify___________

24 On a scale from 1 to 10, do you believe that your current diet provides you with an adequate amount of nutrients to meet your daily needs? (where 1 is not at all and 10 is completely)
1 2 3 4 5 6 7 8 9 10

25 Who looks after most of the shopping and food preparation?
☐ Myself most of the time
☐ My partner
☐ My mother/father most of the time
☐ Other family member (e.g., aunt, sister) most of the time
☐ Shared with other flat mates
☐ The family who billets me
☐ Other, please specify________________

26 Who do you usually eat your evening meals with?
☐ I eat alone
☐ I eat with family/ partner/ flat mate
☐ I eat with friends

27 On average, how many takeaway/ restaurant/ fast food meals do you eat per week?
☐ 0 - 1
☐ 2 - 4
☐ 5 - 7
☐ More than 7

28 On average, how much do you spend on ALL the food and drinks YOU consume in one week? (not including alcohol)
☐ Under $50
☐ $51-$75
☐ $76-$100
☐ $101-$125
☐ $126 or more
☐ Not sure
☐ Other, please specify_________________

*Questions 18-20 were added for the Stage 2 of data collection.
Appendix 15: Changes in body composition

Figure 1 presents changes in body composition over 1-year of university study in 19 female nutrition and dietetics students. Students were allocated into three groups based on meaningful changes in body mass. Meaningful change was define change ≥ 3% of body mass at the time of first data collection (Time 1). Thus, 32% (n = 6) of students experienced decrease in body mass, 32% (n = 6) experienced increase, whilst in 36% (n = 7) body mass remained stable. These changes directly correlated with changes in Body Mass Index and fat mass (as percentage of body mass and in kilograms), but not with fat free mass.

Reference
Figure 1. Changes in body composition over 1-year of university study in 19 female nutrition and dietetics students grouped by individual changes in body mass defined as ≥3% of body mass at Time 1.