Use of a mobile health application in wellness: an assessment of needs, perceptions, usability and efficacy in changing dietary choices in a university student population

by
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Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third-party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

December 2019

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ABSTRACT

Introduction: It is essential to promote wellness in order to improve the health of the population and reduce the cost of healthcare. This study aimed to explore the use of mobile health (mHealth) applications (apps) as dietary self-monitoring tools for wellness purposes, as well as their possible role in the improvement of food choices. One specific app, MyFitnessPal, is explored in greater depth.

Methods: This descriptive, cross-sectional study consisted of two phases, each entailing a corresponding self-administered electronic survey. Undergraduate students (aged 18 to 25 years) served as the sample population. The Phase 1 survey aimed to assess the need for and perceptions of mobile health applications to serve as dietary assessment tools for wellness purposes, and to analyse mobile health app use and various demographic characteristics. The Phase 2 survey was conducted after a three-week period of using MyFitnessPal and aimed to assess the usability of this mobile health app, as well as its perceived efficacy in changing dietary choices. Data was analysed using Stata SE version 15.1. Descriptive statistics were used to describe participant demographic variables. Dietary Instrument for Nutrition Education (DINE) scores were compared using a paired *t*-test. Mean change in scores was calculated with a 95% confidence interval.

Results: The first phase survey was completed by 991 students. The majority of participants indicated that they wanted to improve their diet in order to be healthier and to improve their weight, and that they actively searched for information on how to accomplish this. More than three-quarters (79.31%, *n*=786) of the participants indicated that they were aware of mobile health apps that allow for diet tracking, with less than half of these (42.79%, *n*=423) having made use of any such app. MyFitnessPal was the most popular diet-tracking app that participants had used previously (67.45%, *n*=286). The second phase survey was completed by 61 students. MyFitnessPal was found to be relatively easy to use, with some issues experienced in selecting the right food item from the database, and ensuring the correct portion sizes. Users reported that MyFitnessPal helped them to change their dietary intake and advance towards their personal weight and health goals. Dietary data reflects a significant reduction in high-sugar food intake after the use of MyFitnessPal (*p*=0.030). No change was found in the intake of high-fat foods (*p*=0.910) or fruit and vegetables (*p*=0.980).

Conclusion: Findings demonstrate that a need for diet-tracking health apps exists and that users find them effective in changing their dietary choices. These apps are widely used, perceived as helpful tools by users, and may play a contributing role by increasing individuals' awareness of their eating habits together with providing information on how to optimise food choices. Despite their popularity, there are concerns about the quality and evidence base of the information provided by popular health apps. The use of these types of apps with the guidance of a trained nutrition professional may prove valuable in improving their efficacy.

OPSOMMING

Inleiding: Welstandsbevordering is noodsaaklik ten einde die gesondheid van die bevolking te verbeter en die koste van gesondheidsorg te verminder. In hierdie studie is die gebruik van mobiele gesondheidstoepassings as dieet-selfmonitoringshulpmiddels vir welsynsdoeleindes, asook hul moontlike rol in die verbetering van voedselkeuses, ondersoek. Een spesifieke toepassing ("app"), MyFitnessPal, is in meer diepte ondersoek.

Metodes: Hierdie beskrywende, deursnee-studie het uit twee fases bestaan, elk met 'n ooreenstemmende self-geadministreerde elektroniese opname. Voorgraadse studente (tussen 18 en 25 jaar oud) het as steekproefpopulasie gedien. Die fase 1-opname het ten doel gehad om die behoefte aan en persepsie van mobiele toepassings te evalueer om as dieet-assesseringsinstrumente vir welstanddoeleindes te dien, en om die gebruik van mobiele gesondheidstoepassings en verskeie demografiese eienskappe te analiseer. Die fase 2-opname is uitgevoer na drie weke van die gebruik van MyFitnessPal en was daarop gemik om die bruikbaarheid van hierdie mobiele gesondheidstoepassing, asook die waargenome doeltreffendheid daarvan in die verandering van dieetkeuse te evalueer. Data is geanaliseer met behulp van Stata SE weergawe 15.1. Beskrywende statistiek is gebruik om deelnemer-demografiese veranderlikes te beskryf. Dietary Instrument for Nutrition Education (DINE) tellings is vergelyk met 'n gepaarde t-toets. Mediaanverandering in tellings is bereken met 'n 95% vertrouensinterval.

Resultate: Die eerstefase-opname is voltooi deur 991 studente. Die meerderheid van die deelnemers het aangedui dat hulle hul dieet wil verbeter om gesonder te wees en om hul gewig te verbeter, en dat hulle aktief gesoek het na inligting oor hoe om hierdie doelwitte te bereik. Meer as driekwart (79.31%, n=786) het aangedui dat hulle bewus was van mobiele toepassings wat dit moontlik maak om rekord te hou van dieetkeuses, met minder as die helfte van hierdie groep (42.79%, n=423) wat al ooit gebruik gemaak het van so tipe toepassing. MyFitnessPal was die gewildste dieetopname-toepassing wat deelnemers voorheen gebruik het (67,45%, n=286). Die tweedefase-opname is voltooi deur 61 studente. Daar is bevind dat MyFitnessPal relatief maklik is om te gebruik, met sommige probleme wat ervaar is om die regte voedselitem uit die databasis te kies en om die korrekte porsiegroottes te verseker. Gebruikers het berig dat MyFitnessPal hulle gehelp het om hul dieetinname te verander en vordering te maak te maak wat betref hul persoonlike gewigs- en gesondheidsdoelwitte. Dieetdata weerspieël 'n beduidende vermindering in suikerinname na die gebruik van MyFitnessPal (p=0,030). Geen verandering is gevind in die inname van vetterige kosse (p=0.910) of vrugte en groente (p=0.980) nie.

Gevolgtrekking: Bevindinge toon dat 'n behoefte aan dieet-opname gesondheidstoepassings bestaan en dat gebruikers dit effektief vind in die verandering van hul dieetkeuses. Hierdie toepassings word algemeen gebruik, beskou as nuttige hulpmiddels deur gebruikers, en kan 'n bydraende rol speel deur individue se

bewustheid van hul eetgewoontes te verhoog, tesame met die verskaffing van inligting oor hoe om hierdie bewustheid te optimaliseer. Ten spyte van hul gewildheid is daar kommer oor die gehalte en bewysebasis van die inligting wat deur populêre gesondheidstoepassings verskaf word. Die doeltreffendheid van hierdie tipe toepassings kan verbeter word indien dit onder die leiding van 'n opgeleide voedingskundige gebruik word.

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LIST OF ABBREVIATIONS AND ACRONYMS

BMI   Body mass index

CD   Compact disc

CVD   Cardiovascular disease

DINE   Dietary Instrument for Nutrition Education

MARS   Mobile Application Rating Scale

mHealth   Mobile health

NCD   Non-communicable disease

PDA   Personal digital assistant

SU   Stellenbosch University

WHO   World Health Organization

CONTRIBUTIONS BY PRINCIPAL RESEARCHER AND FELLOW RESEARCHERS

The principle researcher, Cecile Slazus, developed the idea and the protocol for the research project. The principle researcher planned the study, undertook all data gathering and captured the data for analyses. Data was analysed with the assistance of a statistician, Dr CJ Lombard. The principle researcher interpreted the data and drafted the thesis. The study leaders, Mrs Z Ebrahim and Dr N Koen, provided input at all stages of the development of the project and revised the protocol and thesis.

Language and technical editing was done by Dr E van Aswegen, BA (Bibl), BA (Hons), MA, DLitt. Afrikaans language editing was done by Dr Andre Steenkamp, DLitt.

CHAPTER 1: INTRODUCTION

This study aimed at exploring the use of mobile health (mHealth) applications, or 'health apps', as dietary self-monitoring tools for wellness purposes, as well as their possible role in the improvement of food choices. It is a relatively unexplored research area at present. In review of the literature on the topic, the researcher begins by introducing the concept of wellness and presenting a summary of non-communicable disease (NCD) statistics in South Africa, aimed at motivating the need for wellness promotion in the attempt to improve the health of the population. The focus group for wellness promotion is young adults who are at an age where developed behaviours may affect their wellness throughout life. The health behaviour of young adults is presented, highlighting their affinity for mobile technology in their quest to find health-related information. The final part of the review focuses on one such source of health-related information, mHealth apps. One specific app, MyFitnessPal, is explored in greater depth, with the presentation of available literature on the efficacy and use of MyFitnessPal. The review concludes with a summary of the main arguments that prompted the choice of study topic.

CHAPTER 2: LITERATURE OVERVIEW

2.1   INTRODUCTION

The concept of health has, over the years, been extended to include a focus on the promotion of wellness. Dun (1977), cited by Spurr et al., originally examined the notion of wellness, defining it as ´an integrated method of functioning which is oriented toward maximizing the potential of which the individual is capable. It requires that the individual maintain a continuum of balance and purposeful direction within the environment in which he is functioning´. (1)

Physical wellness, one dimension of wellness, can be described as making a continuous active effort to maintain an optimum physical activity level and focus on one´s nutrition, together with making healthy lifestyle choices, practising self-care, and being accepting of one´s physical condition. (2)

Young adults today show disturbing lifestyle behaviours, such as unhealthy behavioural patterns (poor diet, irresponsible use of alcohol, smoking, the misuse of substances) and an increasing obesity rate (3) linked to the long-term development of NCDs. Behavioural risk factors account for around 80% of deaths related to cardiovascular disease (CVD). (4–6) Nutrition is a key modifiable determinant of NCDs and, considering their impact on society, the importance of and need for the establishment of preventative health strategies are broadly acknowledged. (7)

Health promotion is a way to enable individuals to have increased control over their health determinants. The aim is to improve the health and thereby the ability of an individual to lead an active, productive life. (8) This is especially important in young adults who, during the transition from adolescence to adulthood, develop behaviours that will affect their wellness throughout life. (9)

It has been shown that a need exists for the continuous evaluation and monitoring of the dietary choices of, particularly, university students who have been shown to follow a largely unhealthy lifestyle and diet, putting them at an increased risk for the development of an array of NCDs. (10–12) Students have also shown the need for, and willingness to accept, assistance with their dietary habits. (13) With increasing smartphone ownership, (14) young adults have been shown to use their mobile devices to look for health-related information, including how to lose or control weight. (15) The popularity, universality and virtually constant availability of smartphones shape these devices as highly practical platforms for individual dietary self-monitoring. (14) mHealth and wellness apps are very popular, especially those with food and exercise diaries. MyFitnessPal is one of the most popular of these apps and has been shown in a clinical setting to be a useful tool that facilitates the implementation of dietary advice in adults. (16)

2.2   THE CONCEPT OF WELLNESS

The concept of wellness stems from the holistic health concept. In the absence of a standard definition, various authors have described wellness in different ways over time. (17) Descriptions that have been used include: the advancement of an individual towards improving or optimising the quality of their life, health, and social and psychological well-being in positive, practical ways; (18) the concurrent achievement of three different categories of needs (personal, collective and rational); (19) and ´the active process through which people become aware of and make choices toward a more successful existence´. (20) A common theme involves positive lifestyle behaviours, social and environmental receptiveness, and thought processes. (17) Wellness is a concept related to, yet distinct from health. (21) Health is referred to as a ´state´, according to the frequently quoted World Health Organization (WHO) definition – the emphasis is on the presence or absence of disease (on a physical, mental or social level) rather than the practice of specific activities, habits or lifestyles that are positive for the individual, as incorporated in the concept of wellness. (17)

It is evident that wellness cannot be regarded as a unique entity. It is rather seen as a collection of different dimensions, encompassing physical, social, emotional, psychological, intellectual, spiritual, occupational and environmental dimensions of wellness. (2) Physical wellness, in particular, relates to maintaining a healthy body through proper nourishment, exercise and self-care, in order to reduce the risk of disease and injury, as well as provide psychological benefits. (22) Evidence suggests wellness to be the key to academic achievement, with the potential to increase success and future prospects. (23,24) It is essential to promote health and wellness in order to improve the health of the population and reduce the cost of health care. (14)

2.3   THE HEALTH BEHAVIOUR OF YOUNG ADULTS

Young adulthood (18–26 years) is a critical developmental period with long-term implications for the health, well-being and economic security of an individual. This age group represents a key contributor to the workforce of a nation and the healthy development of the next generation. (25)

The lifestyles and health behaviour of university students, nationally and internationally, have been widely studied, highlighting the prevalence of overweight and obesity, unhealthy eating behaviours, low levels of physical activity, immoderate use of alcohol, and the associated elevated risk for the development of NCDs in the long term. (10) A 2014 report on the health and well-being of young adults (18 to 26 years) found that they present with a worse health profile than adolescents and adults who are in their late twenties and thirties (25 to 34 years). (25)

In 2016, research from Stellenbosch University (SU) assessed the health status of the student population (mean age = 20.59 ± 2.17 years, 29% male) and found that mean BMI (23.69 ± 4.29 kg/m^2) and total blood cholesterol increased as the year of study increased, with an elevated risk for the development of NCDs, according to waist circumference, in 18% of females and 6.5% of males. More males, however, were found pre-hypertensive (53.55%) in comparison with females (12.34%), whereas females presented with a higher mean cholesterol level (4.67 ± 0.66 mmol/l) compared with males (4.47 ± 0.46 mmol/l). (26) In this study, 94% of the participating students indicated the need to have wellness programmes on campus, with 47% also indicating that they would like help regarding food choices. (13) Another South African study found that nursing students at a local university had a high prevalence of overweight and obesity, together with poor dietary habits as well as inadequate knowledge of key nutrition issues. (27) The high prevalence of physical inactivity as well as harmful or hazardous alcohol use among university students in South Africa has also been documented. (28,29)

Young adults are in a phase of transition, where their previously structured home and school environment is disrupted and replaced with an environment that is less predictable, but where they have more autonomy over their own health and wellness-related decisions that, as portrayed above, have been documented to be fairly unhealthy. They represent an age group where behavioural foundations resulting from their health-related choices will span into their long-term future, and where they are receptive to dynamic lifestyle changes. They are ideal targets for the development of positive health and lifestyle behaviours through health promotion programmes. (30) Furthermore, they need guidance with regard to their nutritional behaviour (26).

2.3.1 The role of electronic media in health & wellness promotion in young adults

One important aim of health promotion is to empower individuals and make it easier for them to make healthy choices by improving their capacity and social and economic conditions, and creating supportive environments. (8)

By the end of June 2018, more than 4.2 billion people across the world were using the Internet. (31) Literature suggests that the use of the Internet influences the health information-seeking behaviour of individuals. (32) Health information represents one of the most popular online search themes (33) and research shows that health-related information obtained through using electronic media leads to positive health outcomes, proactive health behaviour, increased knowledge, and more economical use of resources. (34,35)

Young adults, in particular, often turn to electronic media or technology for the purpose of obtaining health-related information. (14) They fall within the demographic of the most active smartphone and mHealth app users (36–38), actively searching for information on issues such as weight management. One study found

that college students were more likely to look for health information on the Internet than visit a health or medical professional. (39) Another found that students who had busy schedules, limited healthcare access and financial issues were those more inclined to search the Internet for health information. (40) The continued growth of social media emulates the advances of the Internet; therefore, it is not surprising that, with nearly 2.5 billion worldwide users in 2017 (41), it also serves as a channel through which individuals frequently search for health information. (42) The current interest in and activity surrounding mHealth is significant. (43)

2.4   MOBILE HEALTH APPLICATIONS AND DIETARY SELF-MONITORING

One of many definitions of mHealth is 'medical and public health practice supported by mobile devices'. (44) It is a rapidly expanding field with the potential to improve healthcare with regard to efficiency and quality (45) and help individuals to maintain better health, while helping to control ever-increasing healthcare costs. (46) Furthermore, it has demonstrated to be a very influential tool in empowering individuals in engaging ways, offering convenience in accessing, controlling and managing personal data. (47) This technology is frequently used to encourage healthy lifestyles and address specific health issues, including weight loss and stress reduction. (46)

Third-party apps are autonomous programmes that can be downloaded onto (at a cost or cost-free) and run on a mobile device to expand the utility of the device. (48) In 2008, Apple launched its Apple App Store, initiating what has become a mass market for mHealth apps. (49) Android launched its Android Market (today called Google Play) to users in the same year. (50) Apps were originally developed offering general information and tools such as calendars and email, although owing to rapid technological advancement and an increased demand, they are now able to fulfil a multitude of different functions. (51) In this regard, mHealth apps specifically relate to healthcare. These include health, fitness and medical apps. (52) A November 2017 report on the status and trends in mHealth indicated that there were more than 325 000 mHealth apps available for download across the major platforms, such as Apple and Android, equating to an estimated 3.7 billion downloads. Major app stores added 78 000 new mHealth apps in the same year; however usage is mostly concentrated on 20 or fewer apps for most users. (49) The number of mHealth apps available grew by 284% between 2013 and 2016. (53) mHealth apps account for around two-thirds of all apps available to consumers. Additionally, more than half of the top mHealth apps connect to social media. (54)

There are mixed findings concerning the efficacy of mHealth apps. A 2015 study found that important evidence-based features are lacking in apps used for weight management and that healthcare experts have not participated in their development process; neither has any rigorous scientific testing taken place. An

overall advantage of the use of these types of apps has been suggested by some systematic reviews; however they also called for more controlled trials of high quality in order to test the efficacy of specific in-app features, with the aim of distinguishing the effective components from the ineffective. (55,56)

The Queensland University of Technology developed the Mobile Application Rating Scale (MARS) in 2015, with the purpose of objectively measuring the quality of health apps with regard to engagement, functionality, aesthetics, and quality of information, as well as subjective quality. (57) Since its development, it has been implemented or referenced in various regional and national initiatives aimed at setting guidelines for the development and use of mHealth apps. (58) An Italian version has also been created and validated, (59) and a simplified, user-friendly version in plain English (uMARS) has been developed. (60) The MARS tool has been used to assess apps from several mHealth areas, including weight management, sleep management, mindfulness, glycaemic control, and medication knowledge and adherence. (61)

A report on the international practice in digital apps elaborates on recent academic initiatives from around the world that are focused on regulation of mHealth services, including safety and quality control, and guidelines for recommendation. (58) They are summarised in Table 2.1 below.

Table 2.1:   Initiatives from around the world focused on the regulation of mobile health app services

Country/Region	Initiative/Guideline/Legislation	Initiating Body	Year of Initiation
Andalusia	Safety and Quality Strategy in Mobile Health Apps (62)	Andalusian Public Health System	2012
Australia	Healthy Living Apps Library with over 300 reviewed apps (63)	Victorian Health Promotion Foundation (government funded)	2016
Canada	Guiding Principles for Physicians Recommending Mobile Health Applications to Patients (64)	Canadian Medical Association (CMA)	2015
Catalonia	mHealth Office (65)	Catalan Health Department	2015
France	Good Practice Guidelines on Health Apps and Smart Devices (66)	French Health Authorities	2016
Germany	Digital Healthcare Products: Leveraging Opportunities – Developing Safe Routes to Market (67)	IGES Institute on behalf of Techniker Krankenkasse health insurance company	2016
New Zealand	Guidance on Evaluating or Developing a Health App (68)	New Zealand Ministry of Health	2017
Norway	Self-Declaration Scheme for Mobile Health Applications – Selvdeklareringsordning for Mobile Helseapplikasjoner (69)	Norwegian Government, eHealth Directorate	2016

United Kingdom	Digital Assessment Questions for the assessment and endorsement of apps for the NHS Digital Tools Library (70)	NHS England	2017
	PAS 277:2015: Health and Wellness Apps. Quality Criteria Across the Life Cycle. Code of Practice (71)	British Standards Institution	2015
	Quality Assurance Framework: Mobile Apps for NHS Scotland Healthcare Professional (in progress) (72)	NHS Education for Scotland	2016
United States	Mobile Health App Developers: FTC Best Practices (73)	U.S. Federal Trade Commission	2016
	Xcertia™ (74)	Collaboration: American Heart Association, American Medical Association, The DHX Group, Healthcare Information and Management Systems Society	2017
Cross-Border	Working Group on mHealth Assessment Guidelines (75)	European Commission	2016
	Code of Conduct on Privacy for mHealth (76)	European Commission	2017
	The MAPS Toolkit: mHealth Assessment and Planning for Scale (76)	World Health Organization	2015

*Data from the Report on International Practice on Digital Apps (58)

With many people finding it difficult to meet their personal health and wellness goals, mHealth apps that promote increased compliance could be a helpful tool in empowering individuals to control their own health. (46)

2.4.1 The role of dietary self-monitoring

A systematic review by Tang et al. found that weight loss can be promoted by means of self-directed interventions, of which successful delivery formats include self-monitoring, feedback and social and peer support. (77)

Self-monitoring allows increased awareness of the extent to which an individual is engaged in a specific task. Consequently, behaviour that leads to positive or negative outcomes with regard to the success or failure to meet objectives or goals can be identified quickly. Types of self-monitoring in weight management interventions include regular weighing, recording or tracking of food intake and/or exercise, and tracking the use of television or computers. (78) Dietary self-monitoring (the systematic, detailed observation and recording of intake, or food/diet tracking) is seen as the cornerstone of behavioural treatment of disorders

that are manageable through dietary control and modification. (79) It can raise individuals' awareness of what they eat (80,81) and is one of the most popular tools for body weight management. (79)

Rapid technological advances are providing the potential to improve several aspects of the traditional pen-and-paper method of dietary self-monitoring. (82) Various electronic versions have been developed previously on compact disc (CD), (83) the Internet, (84) or mobile devices such as personal digital assistants (PDAs). (85–87) Currently, individuals monitor their health and dietary behaviour by using mobile technology, health apps, social media and wearables. (88) Mobile health tools are highly portable (and used as such) and practically always available, allowing for constant real-time communication. (89,90) They simplify the process of self-monitoring and thus increase compliance and the validity of self-reported data. (91) Device technology is currently considered an effective method of dietary self-monitoring, in comparison with traditional methods. (92–94)

2.4.2   Mobile health apps related to nutrition and diet

Various mHealth apps are associated specifically with nutrition, with those offering advice or assistance with weight loss and healthy eating being the most popular. (95) Nutrition and diet-related apps accounted for 7.4% of the mHealth app categories in 2014. (96)

These apps can promote a healthy lifestyle through the availability of tools to monitor diet, while encouraging and providing instructions on following a healthy diet regime. (97) Diet-tracking apps allow for the recording of food intake, usually in the form of a food diary, followed by immediate conversion of the input data into nutrient intake and comparison with nutritional goals calculated based on the user's gender, weight, goal weight and physical activity level. (98) Many apps provide the user with information about macronutrients and micronutrients. Some were designed to help users to find recipes appropriate for use in the case of certain health risks or food intolerances or sensitivities. Others can help the user create grocery lists or assist the user with other aspects of the meal-planning process. (99)

Currently used, popular diet-tracking apps that are freely available on Android and iOS platforms are represented in Table 2.2. In a study assessing the quality of various popular Android and Apple mHealth apps, the MARS scores of MyFitnessPal (86%), Noom Coach: Weight Loss Plan (83%) and MyNetDiary (82%) were the highest in the weight loss apps category. (100)

Table 2.2: **Currently available mobile health applications (Android and iOS) that allow for tracking diet**

Mobile Application	Description	Platform
Fitbit	´Live a healthier, more active life with Fitbit, the world´s leading app for tracking all-day activity, workouts, sleep and more.´	iOS Android Windows Phone Web
Noom Coach: Health & Weight	´Noom´s proven psychology-based approach identifies your deep-rooted thoughts and triggers, and builds a custom game plan to help you form healthy habits, faster.´	iOS Android
MyFitnessPal	´MyFitnessPal is a free weight loss app that counts calories. Log exercise and use the large food database to enter your food.´	iOS Android Web
MyPlate Calorie Tracker	´Tracking calories works! Join the millions who have lost weight with LIVESTRONG.COM´s MyPlate Calorie Tracker – the most user-friendly way to track your calories and stay fit on your Andoid Phone.´	iOS Android

Adapted from the Report on International Practice on Digital Apps (58)

Table 2.3 depicts the ten most popular Android diet and nutrition apps in 2019, as stated on the Android News blog.

Table 2.3: **Ten Most Popular Android Diet and Nutrition Apps**

Mobile Application	Description	Cost
FatSecret Calorie Counter	Includes a dietary diary to keep record of food intake (barcode scanner, weight tracker, diet calendar) and calories burnt.	Free
Fooducate	Counts calories, tracks weight loss, tracks exercise. Analyses value of calories consumed. Product database of over 250 000 items and community forum.	Free / Paid
Lose It!	Fitness and health calorie-counting app with food database, dietary plans based on your needs, barcode scanner. Can connect to Fitbit and Jawbone for additional analyses, as well connect to MyFitnessPal, RunKeeper and Google Fit for more data.	Free / Paid

Lose Weight Without Dieting	Calorie and fitness tracker, food database, weight-loss plans, weight tracker and more. Rewards earned for using app consistently – enough rewards earn the user the ad-free version without paying.	Free / Paid
Lifesum	Calorie counting with barcode scanning, meal plans, tracking of progress and macros, recipes, healthy living tips and more. Various diets supported, including keto, low carb, 5:2 and more. Connects with Google Fit and Samsung Health.	Free / Paid
My Diet Coach	Diet and nutrition app that focuses on the urge to eat rather on changing what is eaten. Includes goal setting, tracking of progress, reminders, motivational tips and more.	Free / Paid
MyFitnessPal	Database of over five million foods, sync options with website service, recipe calculator, fitness tracker with cardio and strength-training exercises. The most popular diet and nutrition app.	Free / Paid
MyNetDiary	Calorie-tracker app with at least 600 000 foods, basic fitness tracker, support for connected devices such as Fitbit, Jawbone UP, Garmin and more. Also tracks blood glucose, HbA1C, heart rate, cholesterol and more. Cross-platform support through website service.	Free / Paid
MyPlate Calorie Tracker	Calorie-counting app with food logging, fitness section, integration of Google Fit data, tracking of water intake. Features Android Wear support and a barcode scanner.	Free / Paid
SparkPeople Calorie Counter and Diet Tracker	Diet-tracking app with database of over three and a half million foods, barcode scanner, basic fitness tracker, articles, and cross-platform support.	Free / Paid
*Adapted from the Android News blog, 25 April 2019 (101)		

The experiences and perceptions of adults using freely available nutrition apps for weight management were examined through semi-structured interviews in a 2017 study. The authors found that various nutrition apps were used for varied amounts of time; however MyFitnessPal was the most popular within the study

population. (*n*=24) (102) Other publications have also highlighted its popularity in comparison with other diet-tracking apps. (103)

2.5   MYFITNESSPAL

MyFitnessPal is free and openly available on most mobile platforms. Developers have added an optional, paid premium version allowing access to enhanced features and functions. It has been awarded the highest possible viewer rating in both Android and Apple app stores, with five out of five stars. (103) In the first quarter of 2019, the Facebook page had more than 1.5 million followers (104) and the Instagram page more than 80 000 (105). The company reported having 75 million registered users in 2014. (106)

MyFitnessPal allows users to create profiles, linked to their email address or Facebook account, and to set exercise and weight goals, if they choose. This profile allows users to track what they eat. The user may add foods to the food diary by selecting from the list, or by scanning the barcode of a product. A breakdown of nutrient intake for energy and other macro- and micronutrients is calculated and presented to the user. (Table 2.4) The app also has the ability to connect to and incorporate data from a variety of fitness trackers. There is a community platform, allowing users to communicate with other users. (106)

Table 2.4:   List of nutrients represented in the MyFitnessPal app

Energy
Protein
Carbohydrates
Fibre
Sugars
Fat
Saturated
Polyunsaturated
Monounsaturated
Trans
Cholesterol
Sodium
Potassium
Vitamin A
Vitamin C
Calcium
Iron

It has been claimed that with more than 11 million foods at the time of the study, the app contains the largest nutrition database in the world. This database is the collaborative creation of members of the MyFitnessPal community and staff, with any member having the ability to contribute nutritional information. None of the nutritional information has been reviewed by experts in the field.

The 2016 Mobile App User Guide of the *British Journal of Sports Medicine* featured MyFitnessPal. A short review included a description of the functions of the app, and concluded with positive and negative features. Positive features include its being simple to use, having an extensive food and beverage database, providing detailed nutrition analysis information in understandable ways, the inclusion of goal setting and the integration of the exercise function. Negative features include the fact that any user may add items to the food database, the arduousness of the search function, and the risk of obsession in those at a risk for developing eating disorders. (107) The role of self-monitoring, including using apps such as MyFitnessPal, was the subject of a 2018 study (n=250), where the researchers did not find any evidence to support the fact that daily self-monitoring increases the occurrence of disordered eating behaviours in overweight and obese adults who are attempting to lose weight. (108)

A well-being app review published in *Occupational Medicine*, focusing on weight loss or nutrition and fitness monitoring apps, gave MyFitnessPal an overall rating of 5 stars, described on their rating scale as ´extremely useful (can´t live without)´. Out of 5 stars, 3 stars were awarded for intuitiveness, and 4 stars each for utility, visual attractiveness, and information and content. (109)

The Victorian Health Promotion Foundation in Australia rated MyFitnessPal in their VicHealth Healthy Living App Library. Out of 5 stars, it received an overall rating of 3 stars, 3.5 stars for behaviour change and 4 stars for functionality. (63)

2.5.1 Efficacy and use of MyFitnessPal

The quality of some of the available studies that involve MyFitnessPal is suboptimal.

A usability test by Francisco et al. aimed at inconvenience related to using the app was conducted. Participants in this study found the app to be confusing and difficult to use, indicating that too much detail was required when recording food intake. Some participants were also not convinced by the feedback and weight projections they received on the app. (110)

A randomised controlled trial assessed the effectiveness of MyFitnessPal in achieving weight loss in overweight individuals in comparison with usual care. No difference in weight loss was found after six months, although users did report great satisfaction with the app. This study suffered from major flaws such

as follow up and control group contamination, and therefore results should be interpreted with caution. (103)

A survey among dietitians was conducted across five countries (USA, UK, Canada, Australia, and New Zealand) in order to assess the prevalence of use as well as the perceptions of smartphone-based apps for dietary assessment and monitoring by sports dietitians. In this study, *diet app users* were defined as those sports dietitians who used apps in their practice – either themselves, or advising their use to their clients in order to monitor their diet. It was found that 32% of the 180 dietitians that took part in the survey used apps in their practice, with most (56%) using MyFitnessPal. Participants indicated that they found diet apps to be more effective when used by their clients for self-monitoring, in comparison with being used by themselves as sports dietitians for the assessment of their clients´ diet. (111)

A pilot clinical trial was performed to assess whether MyFitnessPal, in comparison with a traditional written record, was an effective tool for monitoring and reinforcing dietary changes. The focus was on a reduction in sodium intake, with one group using MyFitnessPal and the other group using paper tallying (a three-day food record) in order to record and monitor estimated sodium intake before and after receiving educational material and verbal instructions. The app group showed a trend towards a higher percentage of adherence, had a significant change in sodium excretion after four weeks, and showed a greater level of satisfaction in recording daily food intake. The results from this study suggest that in a small group of healthy adults, MyFitnessPal is a beneficial tool for facilitating the implementation of dietary advice. (16)

A small study (*n*=30) was published on the relative validity of a dietary record using MyFitnessPal. Self-reported dietary intakes using the traditional paper-and-pen method were compared with records using MyFitnessPal, For the analysis of the paper-based record, Brazilian food composition tables were used, focusing on energy, macronutrients and fibre intake. It was found that MyFitnessPal demonstrated good relative validity for energy and fibre intake. (112)

Another study (*n*=43) had participants record their dietary intake in MyFitnessPal for four consecutive days, and compared it with the results from two random researcher-administered 24-hour recalls. The focus was on which foods were omitted from the MyFitnessPal record. Results indicated that a mean of 18% of food was omitted, in particular nutrient-poor and energy-dense foods. Energy and macronutrient intake were found to be consistently lower than results from the 24-hour recalls indicated. Finally, difficulties reported in usability involved matching food items, estimating serving sizes, the time-consuming data-entry process, and the lack of motivation or willingness to use the app on a regular basis. (113)

One prevailing conclusion in the abovementioned studies is the need for larger and more high-quality studies on mobile health apps like MyFitnessPal, including assessing the validity of nutrient measurements and analyses, and individuals´ usability experiences.

2.6   SELF-ADMINISTERED ONLINE QUESTIONNAIRES IN RESEARCH

Questionnaires are often used to gather data in epidemiological research. Self-administered questionnaires have inherent advantages and disadvantages. As an interviewer is not involved, it can be completed anonymously and interviewer variation is not a factor. It is usually less time-consuming and costly than other methods such as interviewer-administered questionnaires, interviews or telephone surveys. Respondents need to be literate, and it is important that the questionnaire is clear and well laid out. There is also little control over the quality of the data that is gathered using self-administered questionnaires. Use of an electronic or online version of a self-administered questionnaire is applicable in specific research groups where web-based activities may be prioritised, consequently enhancing response.   With online questionnaires, respondents from a large geographical area can be reached. Depending on the population, online questionnaires may have a low response rate, considering it is limited to respondents who have internet access and are computer literate. (114)

2.7   CONCLUSION AND RATIONALE FOR STUDY

It is essential to promote wellness in order to improve the health of the population and reduce the cost of healthcare. (14) Literature on the rising global prevalence of NCDs and their concomitant burden on public health is ample. The lifestyle and health behaviour of young adults, in particular university students, is associated with an increased risk of developing these diseases in the long term. (10) There is literature available on these behaviours, including inactivity, poor nutritional habits and excessive drinking, (30), as well as on the anthropometric and biochemical parameters, such as increased waist circumference, systolic blood pressure and dyslipidaemia, that illustrate the associated risk for the development of NCDs in this population, in South Africa and globally. (26,115) Students have been shown to deem their health important and the need for assistance with dietary habits has been expressed. (13) Literature supports the continuous evaluation and monitoring of dietary choices. (10,12)

This study explored mHealth apps used as dietary self-monitoring tools to potentially assist in the endeavour to improve eating habits and consequently overall wellness; the need for and perceptions of these types of mobile health apps, as well as their usability and users´ perceptions of whether they assist in changing their food choices. This thesis outlines the methodology and results of the study, summarising findings in a discussion, and concludes with recommendations based on presented findings, noting all relevant limitations.

CHAPTER 3: METHODOLOGY

3.1 RESEARCH QUESTION

The study was designed to answer the question: Is there a need for, and what are the perceptions of, mobile health apps serving as dietary assessment tools for wellness purposes in university students aged 18 to 25 years? Additionally, what are the usability and perceived efficacy of one such mobile health app, MyFitnessPal, in changing dietary choices?

3.2 AIMS AND OBJECTIVES

The aim was to assess the need for and perceptions of mobile health applications to serve as dietary assessment tools for wellness purposes in undergraduate university students aged 18 to 25 years, and to assess the usability and perceived efficacy of one such mobile health application, MyFitnessPal, in changing dietary choices.

3.2.1 Objectives

Phase 1:

- To assess the need for mobile health applications to serve as dietary assessment tools for wellness purposes
- To assess the perceptions of mobile health applications in the study population
- To compare demographic characteristics of study participants with awareness, use and purchases of mobile health applications

Phase 2:

- After use of the mobile health application MyFitnessPal, to assess its usability and perceived efficacy in changing dietary choices
- To compare dietary intake data before and after the use of the mobile application MyFitnessPal

3.3   STUDY PLAN

3.3.1   Study type

This descriptive, cross-sectional study consisted of two phases, each entailing a corresponding self-administered electronic survey. Both surveys collected quantitative data.

3.3.2   Study population

Undergraduate students registered at SU in 2018 served as the sample population. Census sampling was used to recruit study participants; thus, all registered undergraduate students were contacted by email. Contact information was obtained from the Research Information Support Office at SU and use was limited to the SunSurvey portal, used for the setup and distribution of both surveys used in this study – see Section 3.7, Ethical and Legal Considerations.

Phase 1:

The inclusion criteria were full-time undergraduate students at SU, registered in 2018, between the ages of 18 and 25 years, who volunteered to take part in the first phase of the study, provided informed consent, and had access to the Internet and email.

The exclusion criteria comprised individuals who participated in the pilot study.

Phase 2:

The sample population were those participants in *Phase 1* that indicated their willingness to participate in *Phase 2*.

The inclusion criteria were individuals who took part in the first phase of the study and agreed to take part in the second phase, who provided informed consent, and who owned a mobile device that could run MyFitnessPal.

3.3.3   Sample size

Epi Info™ statistical software (Version 7.2, CDC, Atlanta, GA, USA) was used to calculate the required sample size for this population survey.

Phase 1:

For statistical purposes, the sample size needed for Phase 1 was calculated by a statistician to be 267 study participants. This calculation was done assuming a population size of 19 844 students (number derived from 2017 student registration data (116) obtained in August 2017 from the SU Institutional Research and Planning Officer), 50% level of knowledge regarding the topic among the students, with a 95% confidence interval and a margin of error of 6%. To reach the planned sample size, a response rate of 1.3% was necessary.

Phase 2:

For this phase (a pilot study), in order to accommodate for those study participants lost to follow-up, the researcher aimed to attain a sample size of 20% of the total number of participants that took part in Phase 1. This represents a required minimum sample of 52 participants.

3.3.4   Methods of data collection

The researcher obtained all relevant approval and conducted a pilot study prior to the start of data collection. Please refer to the quality control section below for more information on the pilot study.

Data collection was a two-phased process. Surveys for both phases were constructed using Checkbox 4.7 through SunSurvey (SU web-based e-survey service), and sent as a link in an email body through the same service.

The Phase 1 study population´s email addresses were loaded onto the researcher´s Checkbox dashboard in four groups by the Research Information Support Services at SU. Groups were necessary to avoid overloading the system when sending emails in batches. Email addresses were grouped as follows:

Group 1: n=4899

Group 2: n=6071

Group 3: n=4100

Group 4: n=4598

Both surveys contained details of the study and a partial waiver of consent. Consent was needed in order to access and complete each survey. Study details and consent information were available in English and Afrikaans. Survey questions were developed based on a review of current literature and relevance to the objectives of the study. Surveys were available in English.

3.3.4.1   Phase 1: Assessment of needs and perceptions of mobile health applications

The data-collection period for the first phase was in August 2018. The sample population received an email containing a link that could be used to access the self-administered electronic survey. It was available for

completion for a period of two weeks. A reminder email was sent to each potential participant after one week.

The first-phase survey, represented in Addendum A, contained four sections, (a) socio-demographic information, (b) lifestyle and dietary information, (c) mobile health application usage, and (d) follow-up information, each containing a series of closed-ended questions, including multiple-choice questions (some with an open-ended 'other' option), Likert scale and yes/no questions. Survey questions were developed after revision of the available literature, including interview data on how college students choose mobile health and wellness apps by Choi and Stvilia (39).

- Section A, the socio-demographic information section, contained short questions requesting general demographic information.
- Section B, the lifestyle and dietary information section, requested the self-reported weight and height of the participant, and contained short questions on dietary routine. Baseline self-reported dietary intake was measured by means of an adapted version of the Dietary Instrument for Nutrition Education (DINE). (117)
- Section C, the section on mobile health application usage, enquired about mobile device ownership and use, focusing on general use of health apps.
- Section D, the follow-up information section, requested the participant to indicate whether he/she was interested in taking part in the final phase of the study.

Once all questions were answered, the participant could submit the survey online. Responses were electronically available to the researcher for export to Microsoft Excel for further analysis.

3.3.4.2 Phase 2: Assessment of usability and perceived efficacy of MyFitnessPal

The second phase was conducted as a pilot study. The data-collection period for this phase was in September and October 2018.

Stage 1:

Participants from the first phase that indicated their willingness to participate in the second phase were manually grouped. This group of participants received an email in September 2018 to download and use the mobile health app MyFitnessPal for a period of three weeks. They were asked to (a) set up a profile, (b) set up goals (if they wished), (c) track their daily food intake as much as possible, and (d) take note of the health information provided by the app, in order to complete a follow-up survey at the end of the three-week period based on their experience in using the app.

Stage 2:

After using MyFitnessPal for three weeks, participants received an email with the link for the second self-administered electronic survey in October 2018. The survey was available for completion for one and a half weeks.

The second-phase survey, represented in Addendum B, contained three sections: (a) the usability of MyFitnessPal, (b) the efficacy of MyFitnessPal, and (c) the follow-up information, each containing a series of closed-ended questions, mostly Likert scale and yes/no questions, and one open-ended question. Survey questions were developed after revision of the available literature, including a survey used by Ipjian and Johnston in a study on smartphone technology and dietary change (16), and a survey by Laing et al. on MyFitnessPal (103).

- Section A, the usability of MyFitnessPal, contained questions on the participants´ experience in using the app, whether they experienced any difficulties and whether they were partial to the information provided by the app.
- Section B, the efficacy of MyFitnessPal, contained questions on how the participants used the app, whether they felt that the app helped to improve their food choices, as well as requesting their current weight. Self-reported dietary intake was again measured by means of the adapted version of the DINE tool. (117)
- Section C, follow-up information, requested information related to the incentive for participation – see Section 3.7, Ethical and Legal Considerations.

Once all questions were answered, the participants could submit the survey online. As previously, responses were electronically available for export to Microsoft Excel and further analysis.

3.3.4.3   Quality control

As surveys in general are subject to selection bias, efforts to limit such bias and assure that all students were reached included a) performing data gathering outside of any exam periods, and b) sending recruitment emails to students' university email addresses, actively used for university correspondence during the semester.

An effort was made to maximise response to surveys, increasing the effective size of the sample and decreasing sampling error. Strategies included sending reminder emails midway through each data collection period, constructing surveys to be user-friendly and relatively quick to complete and submit, stating survey questions concisely, and offering incentives with a monetary value for participation in each phase.

In an attempt to limit the submission of implausible or missing data, surveys were constructed electronically and in such a way that all questions needed to be answered in order to successfully submit the survey.

The validity of the first-phase survey was tested before commencing data gathering. Content was validated by four experts in the field of nutrition and epidemiology, and updates were made according to their feedback. Face validity was tested by means of a pilot study. The sample population consisted of six volunteers from the first-year dietetics class at SU Division of Human Nutrition, who responded to a recruitment email and completed an assessment of the survey. One question was reworded based on participant feedback.

The content validity of the second-phase survey was also tested before commencing data gathering. Content was validated by four experts in the field of nutrition and epidemiology and updates were made according to their feedback.

Prior to analysis of the data obtained from the electronic surveys, data was verified for any errors in the source information, transcription and data entry. This included checking for implausible or missing categorical and numerical variables, and cross-checking of variables.

3.4   DATA ANALYSIS

3.4.1   Self-reported weight and height

Self-reported weight and height data, obtained from the electronic surveys, were used to calculate body mass index (BMI) using the calculation below:

$$BMI = \frac{weight}{height^2}$$

BMI values were interpreted according to WHO guidelines (118) (adapted from WHO, 1995, 2000, 2004), presented below (Table 3.1):

Table 3.1   WHO classification for the interpretation of body mass index

Classification	BMI (kg/m²)
Underweight	<18.5
Severe thinness	<16
Moderate thinness	16 – 16.9

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Mild thinness	17 – 18.4
Normal range	18.5 – 24.9
Overweight	≥25
Pre-obese	25 – 29.9
Obese	≥30
Obese class I	30 – 34.9
Obese class II	35 – 39.9
Obese class III	≥40

3.4.2   Adapted Dietary Instrument for Nutrition Education (DINE)

The adapted DINE (117), based on the validated full version of the tool (119), was used to estimate the extent to which the use of MyFitnessPal effected changes in self-reported dietary choices in this study. The adapted version is a shortened version, reducing participant burden.

Data collected from a series of short questions fall into one of three categories:

- Fatty foods
- Sugary foods
- Fruit and vegetables

The same set of questions was used in both surveys and is presented in Table 3.2 below. The table also indicates the score allocated for each possible answer.

Table 3.2:   Dietary Instrument for Nutrition Education (DINE): Score Allocation

CATEGORY	QUESTION NUMBER	QUESTION	SCORING			
FATTY FOODS	1	**How many times did you eat a serving of the following foods over the last 7 days?**				
	1a.	Cheese	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	6	9
	1b.	Beef burgers or sausages	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	6	9
	1c.	Beef, pork or lamb	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	6	9
	1d.	Fried food	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	6	9
	1e.	Pies, quiches or pastries	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	5	6
	1f.	Crisps or fast food	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	5	6
	1g.	Bacon or other processed meat	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	5	6
	1h.	Chips	No times	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	6	9
	2	**Over the last 7 days, how much milk have you used per day for drinking or in cereal, tea or coffee?**	Less than 125ml	About 125ml	About 250ml	500ml+
		SCORE	1	2	3	4
	3	**What kind of milk do you usually use?**	Full cream	Low fat	Fat free	
		SCORE	3	2	1	
FRUIT & VEGETABLES	4	**Over the last 7 days, how many times have you eaten fruit and vegetables per day?**	Less than once	1 – 2 times	3 – 5 times	6+ times
		SCORE	0.5	1.5	4	6
SUGARY FOODS	5	**Over the last 7 days, how many times per day did you eat or drink the following:**				
	5a.	Chocolates or sweets	Less than once	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	3	4
	5b.	Biscuits	Less than once	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	3	4
	5c.	Sugary drinks (fizzy drinks, diluting juice or fruit juice)	Less than once	1 – 2 times	3 – 5 times	6+ times
		SCORE	1	2	3	4

The scores allocated to each question, shown in the table above, were used to calculate a score for each of the categories.

Table 3.3 shows which variables were used to calculate the scores and the possible score range for each category. High scores indicate high intake of the relevant food category; scores higher than 60 in the case of fatty foods, higher than 8.67 in the case of sugary foods, and higher than 3.67 in the case of fruit and vegetables.

Table 3.3   **Dietary Instrument for Nutrition Education (DINE): Variables included in each food category**

Category	Variables Included	Possible Score Range
Fatty Foods	Cheese	8–68
	Beef burgers or sausages	
	Beef, pork or lamb	
	Bacon or processed meat	
	Pies, quiches or pastries	
	Crisps or fast food	
	Fried foods + Chips/2	
	Milk frequency x milk type	
Sugary Foods	Sugary drinks	3–16
	Chocolates or sweets	
	Biscuits	
Fruit and Vegetables	Fruit and vegetables	0.5–6

3.5   STATISTICAL ANALYSIS

Statistical support was provided by the Biostatistics Unit of SU. All captured data from the electronic surveys were exported to Microsoft Excel 2016 and analysed using data analysis software Stata SE version 15.1 (StataCorp LLC, www.stata.com).

For Phase 1, descriptive statistics were used to describe participant demographic variables. Data were not tested for normality; however through observation by the biostatistician, data were found to be normally distributed. Mean was used as measure of central location and standard deviation as indicator of spread. Distribution of variables was presented with frequency tables. The relationship between categorical variables such as demographic characteristics and app awareness were analysed with association tests, chi-squared and Fisher´s exact tests.

For Phase 2, descriptive statistics were used to describe participant demographic variables, where mean was used as measure of central location and standard deviation as indicator of spread. Frequency tables were used to present the distribution of variables, and boxplots used for graphical illustration.

The agreement between self-reported weight and target weight was assessed using concordance analysis. Lin´s concordance correlation coefficient was estimated including the 95% confidence interval.

Intake frequencies before and after use of MyFitnessPal were compared using a test for marginal homogeneity, taking into account the correlated data.

DINE scores before and after use of MyFitnessPal were compared using a paired *t*-test. Mean change in scores was calculated with a 95% confidence interval.

3.6   BUDGET

The compiled list of research expenses is provided in Table 3.4. All costs were covered by the researcher.

Table 3.4:   **Research project budget**

Component	Motivation	Financial Requirements		
		Cost/unit	Units required	Total Cost
Operational Costs				**R6 000.00**
Phase 1: Participant Incentives	Lucky draw with 2 winners	R1 000	2	R2 000.00
Phase 2: Participant Incentives	Lucky draw with 2 winners	R2 000	2	R4 000.00
Services				**R9 500.00**
Language editing	Editing of the final project prior to submission and publication	Dependent on submitted text	1	R8 000.00
Printing and binding	Printing and binding of final thesis	Dependent on submitted text	3	R1 500.00
BUDGET TOTAL:				**R 15 500.00**

3.7 ETHICAL AND LEGAL CONSIDERATIONS

Ethical approval (Addendum C) for this study was granted by the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences of SU in December 2017 (Project number: S17/10/247). Institutional permission (Addendum D) was granted from SU in February 2018 (Reference number: IRPSD 784).

The researcher contacted MyFitnessPal to request permission to use their mobile app for the purpose of the study. Permission was granted as follows: the name of the app may not be used in the title of the study, the name of the app may be used for study and publication purposes (in the correct format); however logos or images may not be used as they are trademarked and copyrighted property of Under Armour, Inc. The researcher was also requested to add a disclaimer statement within the thesis to acknowledge no affiliation with MyFitnessPal or Under Armour. Findings from the study will be reported to Under Armour to assist in improving the MyFitnessPal mobile app.

All participants needed to provide consent in order to participate in this study. Both electronic surveys included a partial waver of consent as an introductory section, containing all the necessary information in order to make an informed decision. The surveys could only be completed by clicking the appropriate box once participants had given consent. Without ticking the box, the participant was not granted access to, and could not complete and submit, the electronic survey.

Privacy and confidentiality were respected at all times. Data has been de-identified as far as possible. Any identifying information was and will be kept confidential. All gathered data was and will be used only for the purpose of this study.

To encourage participation in the study, each of the two phases had two lucky draw prizes. In the first phase, two randomly chosen participants received a shopping voucher to the monetary value of R1000 each. In the second phase, two randomly chosen participants received a shopping voucher to the monetary value of R2000 each.

CHAPTER 4: RESULTS

The results of this study are presented according to the defined objectives. Phase 1 and Phase 2 objectives are presented separately, including demographic data for the representing sample of each phase. Remaining subsections follow the relevant sections from the corresponding participant survey for each phase.

4.1   PHASE 1

For the first phase of the study, the electronic survey was sent to the study population per email in four batches. The Checkbox email invitation report indicated that a total of 19 662 surveys were sent for the first phase. Some surveys were not delivered because of faulty email addresses loaded onto the system. A final total of 19 643 emails were sent and delivered as part of Phase 1, of which 992 students completed and submitted the first electronic survey assessing the need for and perceptions of mobile health applications that track dietary intake. Of these, one student took part in the pilot study and was excluded from the final study population. The final study population for Phase 1 thus consisted of 991 registered, undergraduate students at SU between the ages of 18 and 25 years. This reflects a response rate of 5.05%; high in comparison with the planned 1.30%.

For the second phase pilot study, of the 991 students that took part in the first phase, 61 met the inclusion criteria, used the MyFitnessPal mobile app for a period of three weeks and continued to complete and submit the second electronic survey assessing the usability and perceived efficacy of the MyFitnessPal app. This reflects a response rate of 6.16%; lower than the planned 20.00%; however, based on a smaller sample size, the response rate is nevertheless substantial.

4.1.1   Demographic data

The demographics of the Phase 1 study population are summarised in Table 4.1. Of the 991 participants, 65.89% (*n*=653*)* were female. The mean age of study participants was 20.78 (SD ±1.51). Considering race, more than half (65.89%, *n*=653) of the participants indicated that they were white, with 15.44% (*n*=153) reporting coloured, 12.92% (*n*=128) black, and 5.75% (*n*=57) participants from other races. Study participants indicated a wide range of home languages representing all 11 official languages of South Africa together with other African, European, Middle-Eastern and Asian languages. The majority of participants were native English (49.04%, *n*=486) and Afrikaans (37.54%, *n*=372) speakers, and lived either on campus in residence (43.19%, *n*=428) or in shared private accommodation (33.40%, *n*=331) at the time of the study. Most of the participants were in their early years of studies: 34.41% (*n*=341) in their first year, 26.94% (*n*=267) in their second year, and 22.81% (*n*=226) in their third year.

Table 4.1:   Phase 1 Respondent Demographics (*N*=991)

Demographic characteristic	Frequency (*n*)	Percentage (%)
Gender		
Female	653	65.89
Male	338	34.11
Race		
African	128	12.92
Mixed ancestry	153	15.44
Caucasian	653	65.89
Other	57	5.75
Home Language		
Afrikaans	372	37.54
English	486	49.04
isiNdebele	2	0.20
IsiXhosa	31	3.13
isiZulu	19	1.92
Sepedi	12	1.21
Sesotho	10	1.01
Setswana	10	1.01
SiSwati	7	0.71
Tshivenda	4	0.40
Xitsonga	3	0.30
Other	34	3.43
Accommodation Type		
Campus residence	428	43.19
Parental home	125	12.61
Private accommodation (alone)	107	10.80
Private accommodation (sharing)	331	33.40
Year of Studies		
1st year	341	34.41
2nd year	267	26.94
3rd year	226	22.81
4th year	113	11.40
5th year	30	3.03
6th year	12	1.21
7th year	1	0.10

4.1.2   The need for mobile health applications to serve as dietary assessment tools for wellness purposes

Data on weight and height were self-reported. The number of participants within the five BMI categories are illustrated below in Figure 4.1. The majority of participants had BMI values within the normal range (63.88%, *n*=612). The remaining participants had BMI values classified as overweight (21.19%, *n*=203), obese (7.83%, *n*=75), underweight (5.53%, *n*=53) and morbidly obese (1.57%, *n*=15).

31
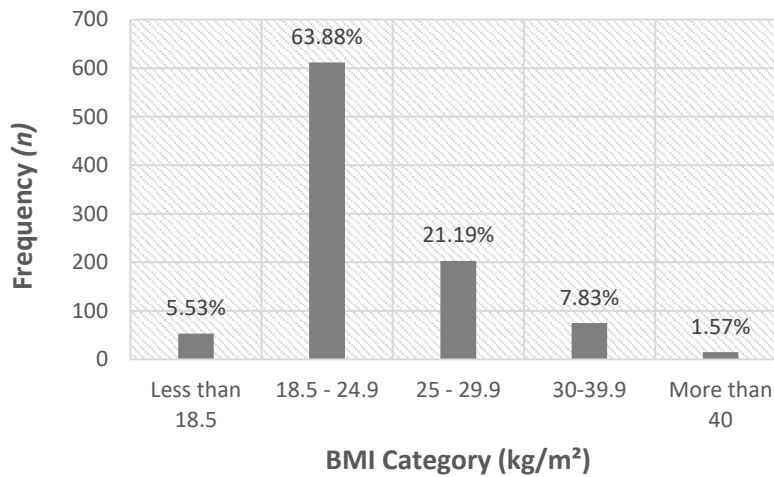
Figure 4.1: Frequency of participants in the five BMI categories in phase 1 (from self-reported data) (*N*=991)

Upon further observation, gender distribution of BMI was similar, with the mean female BMI being 23.51 (SD±4.92) and mean male BMI being 24.83 (SD±5.30). Cross-tabulation of male and female BMI values (Pearson Chi²=20.25, *p*<0.001) indicated that more males were overweight (26.91%, *n*=88) and obese (10.70%, *n*=35) than females (16.96% overweight, *n*=107, 8.71% obese, *n*=55).

Participants were asked to choose a statement that correlates with how they feel about their current weight (Figure 4.2). More than half of the participants indicated that they wanted to lose weight, with 36.02% (*n*=357) wanting to lose between 1 and 4 kilograms, and 28.25% (*n*=280) wanting to lose 5kg or more. A statistically significant association was found between the participants´ gender and how they felt about their weight (Pearson Chi²=143.09, *p*<0.001), with males more frequently indicating that they are happy with their weight or they want to gain weight, and females mostly indicating that they want to lose weight.

Figure 4.2: Participant statements on how they feel about their current weight (*N*=991)

Participants were asked where they consume most of their meals (Figure 4.3). Most of the participants (58.22%, *n*=577) indicated that they consume mostly homemade meals at home, with others mostly eating at their campus 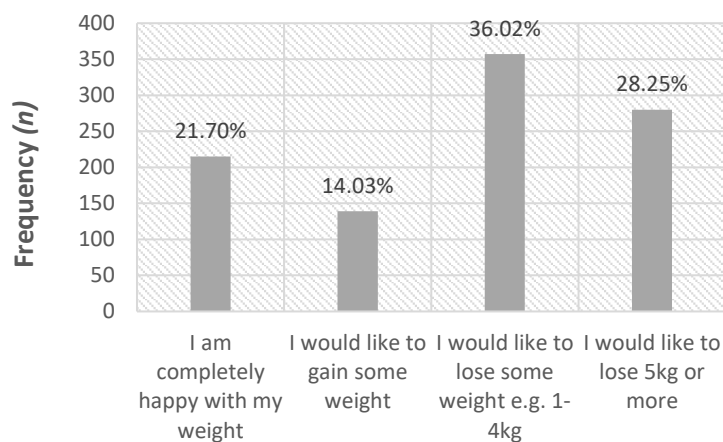or residence cafeteria (24.62%, *n*=244), making ready-made meals at home (9.89%, *n*=98), eating takeaways at home (3.73%, *n*=37) or eating at restaurants, coffee shops or delis (3.03%, *n*=30). When asked how often they think they consume a healthy balanced diet, more than half (53.08%, *n*=526) of participants indicated mostly, and 3.03% (*n*=30) indicated that they never consume a healthy balanced diet. No significant association was found between gender and how often participants think they consume a healthy diet (Pearson Chi^2=4.63, *p*=0.20).
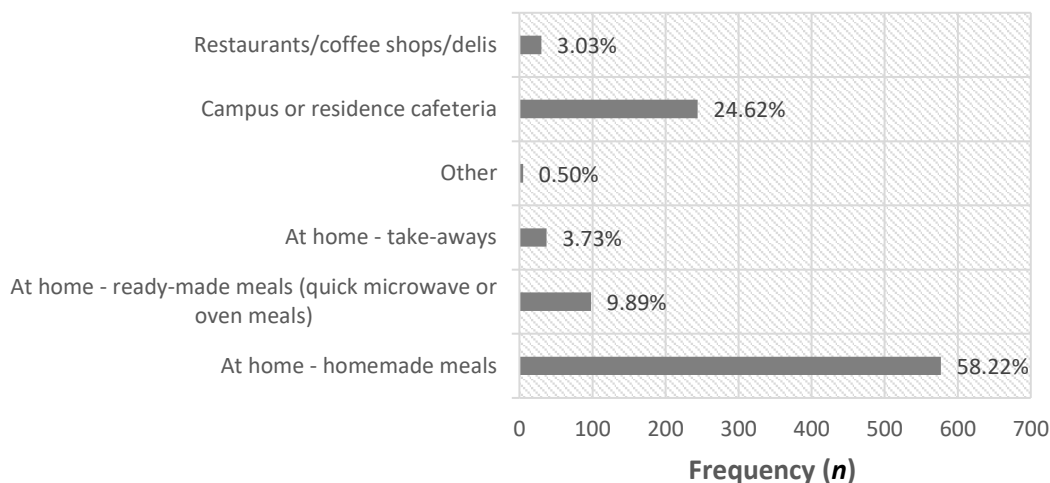
Figure 4.3: **Participant statements on where they consume most of their meals (*N*=991)**

Participants were asked, in two separate questions, whether they wanted to improve their diet in order to (a) be healthier, and (b) improve their weight: 89.71% (*n*=889) indicated that they wanted to improve their diet in order to be healthier, with 74.17% (*n*=735) wanting to improve their diet in order to improve their weight. A statistically significant association was found between gender and wanting to improve dietary intake in order to improve health (Pearson Chi^2=9.87, *p*=0.002) and weight (Pearson Chi^2=28.82, *p*<0.001). A statistically significant association was also found between participant BMI and wanting to improve dietary intake in order to improve weight (Pearson Chi^2=30.76, *p*<0.001), with a larger percentage of participants wanting to improve their diet in order to improve their weight as BMI increases.

The majority of the participants (55.70%, *n=552*) indicated that they actively searched for information on how to improve their diet. A statistically significant association was found between gender and searching for information on dietary improvement (Pearson Chi^2=39.20, *p*<0.001), with females more likely to actively search for information on how to improve their diet. No association was found between age or BMI (Pearson Chi^2=6.73, *p*=0.15) and actively searching for information on dietary improvement. Statistically significant associations were found between those who indicated the willingness to improve their diet in order to

improve their health (Pearson Chi^2=42.19, *p*<0.001) and weight (Pearson Chi^2=69.03, *p*<0.001), and the active search for diet-related information. Similarly, a positive association was found between how often participants thought they consumed a healthy diet and the active search for information on dietary improvement (Pearson Chi^2=16.92, *p*=0.001). The most popular sources used to find this information was electronic media such as the Internet and social media (79.31%, *n*=786), family and friends (41.17%, *n*=408), and print media such as newspapers and magazines (14.83%, *n*=147). Health workers such as doctors, nurses or dietitians were cited by 9.69% (*n*=96*)* of participants, whereas 11.50% (*n*=114) were not interested in finding diet and health- related information at the time (Figure 4.4).
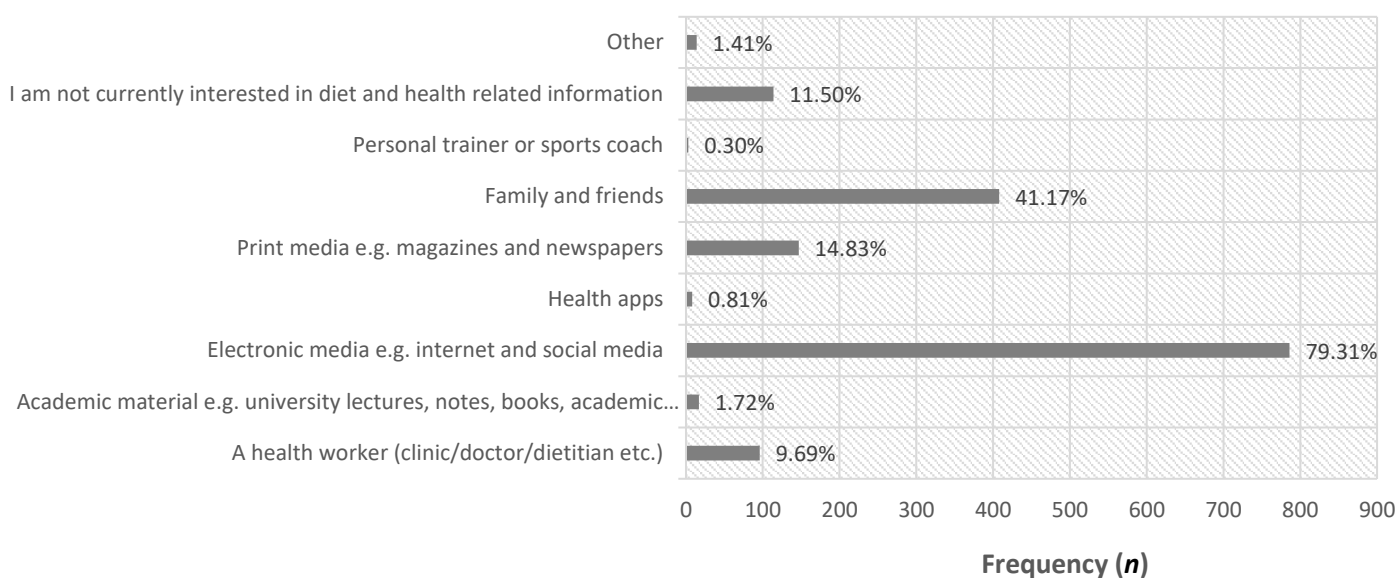
Figure 4.4:   **Participant statements on which sources they use to find diet and health-related information (*N*=991)**

The majority of participants (99.50%, *n*=986) were the owners of a smartphone, with the most popular devices used running the Android or Windows operating systems (64.68%, *n*=641) and the rest (35.32%, *n*=350) using devices that run iOS. Most of the participants had a phone contract (63.67%, *n*=631), with the remaining participants (35.02%, *n*=347) having the pay-as-you-go or prepaid payment option.

4.1.3   The perceptions of mobile health applications

More than three-quarters (79.31%, *n*=786) of the participants indicated that they were aware of mobile health apps that allow for diet tracking, with less than half of these (42.79%, *n*=424) having ever made use of any such app and 3.77% (*n*=16) of these having ever paid for such an app. A significant association was found

between gender and the awareness (Pearson Chi^2=4.04, *p*=0.044) and use of health apps (Pearson Chi^2=39.60, *p*<0.001). A statistically significant association was also found between those participants that searched actively for health information and also use health apps (Pearson Chi^2=90.54, *p*<0.001). Women (81.19%, *n*=530) were more aware of health apps that allow one to track dietary intake than men (75.74%, *n*=256), and more women (49.85%, *n*=326) than men (28.99%, *n*=98) indicated that they had used health apps previously. Most of those participants that were actively searching for information on improving their diet (73.11%, *n*=310) also indicated that they have made use of health apps. A statistically significant association was found between how often the participants thought they consumed a healthy, balanced diet and the use of health apps (Pearson Chi^2=47.39, *p*<0.001). No association was found between the use of health apps and BMI (Pearson Chi^2=9.30, *p*=0.054); however participants with a BMI over 30 had the lowest use.

Of those participants who had used diet-tracking apps previously (42.79%, *n*=423), most learned of these apps (Figure 4.5) through electronic media such as the Internet and social media (77.59%, *n*=329), 35.14% (*n*=149) heard about diet-tracking apps through family and friends, and 7.31% (*n*=31) through print media such as magazines and newspapers. The remaining participants indicated that they heard about health apps that allow you to track your diet through health workers such as doctors or dietitians (8.73%, *n*=37) and the app store on their mobile device (2.12%, *n*=9). Other sources were indicated by 2.12% (*n*=9) of the participants: that the apps came with their phone´s software, school and sports coaches, and diet groups (banting revolution). The majority of participants downloaded health apps from the app store on their mobile device (96.46%, *n*=409), with 13.68% (*n*=58) downloading health apps from electronic media such as the Internet and social media.
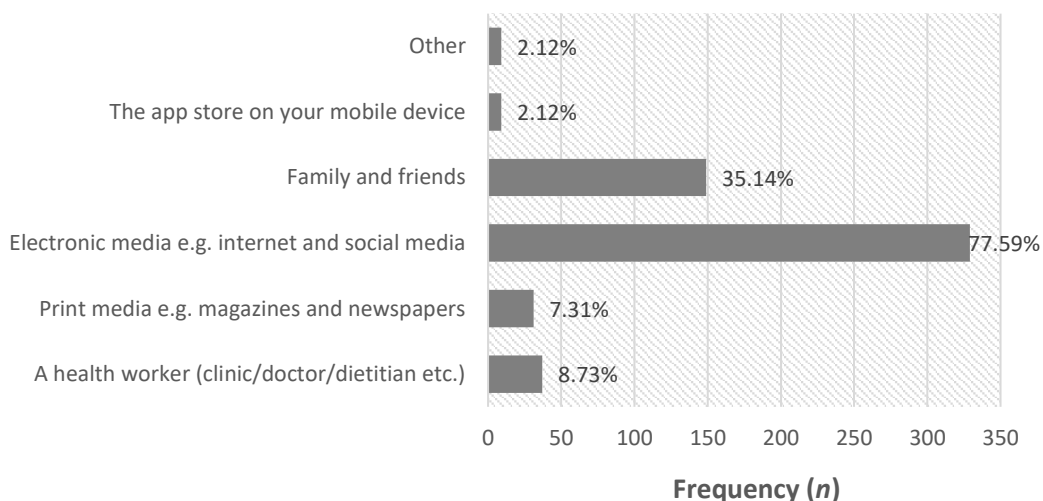

Figure 4.5: **Participant statements on where they heard about health apps that allow you to track your dietary intake (*N*=423)**

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MyFitnessPal was the most popular diet-tracking app that participants had used previously. Table 4.2 shows other popular apps mentioned by participants. With regard to the regularity of use, 36.17% (n=153) of participants indicated that they made use of a diet-tracking app every day, 24.35% (n=103) used a health app a few times and never again, 24.11% (n=102) a few times per week, 8.98% (n=38) at least once per week, and 5.91% (n=25) a few times per month.

Table 4.2: Health apps previously used by participants (N=423)

Health app	Frequency (n)	Percentage (%)
MyFitnessPal	286	67.45
My Food Diary	56	13.21
Samsung Health	34	8.02
Lose It!	31	7.31
Calorific	19	4.48
FatSecret	15	3.54
FitBit	15	3.54
MyPlate	15	3.54
MyNetDiary	11	2.59
Other	78	18.40
My Diet Coach		
Cronometer		
DailyDozen		
Lifesum		
Calorie Counter: Easyfit		

The majority (67.45%, n=286) of participants indicated that they were not willing to pay for a diet-tracking app, with the remaining participants mainly willing to spend between R1 and R50 (23.35%, n=99) and R51 and R100 (8.02%, n=34) on apps such as this. No association was found between gender and the amount participants were willing to spend on diet-tracking apps (Pearson Chi^2=4.66, p=0.324).

Of the participants that had never used a diet-tracking app (57.21%, n=567), 65.43% (n=371) indicated interest in finding out more about these types of apps. A statistically significant association was found between gender and the interest in finding out more about diet-tracking apps (Pearson Chi^2=6.42, p=0.011), with females showing a higher interest compared with males. Participants provided a variety of reasons as to why they have never used a mobile health app in order to track their diet (Figure 4.6), with the most popular reasons being lack of time (33.51%, n=190), lack of trust that the apps will accurately analyse their diet (29.98%, n=170) and not being interested in these apps (28.22%, n=160). Other reasons were indicated by 17.28% (n=98) of the participants. Some other reasons mentioned included not knowing where to find

these apps, and believing that these types of apps play a role in the development of unhealthy or obsessive food behaviours such as eating disorders.
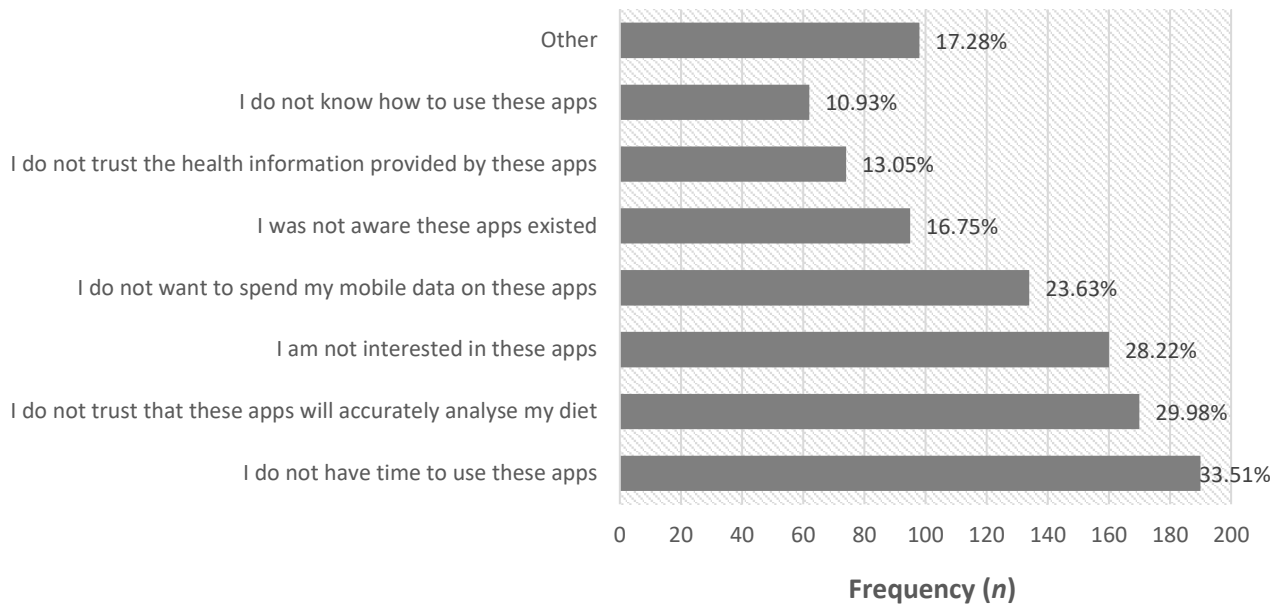
Figure 4.6: **Participant statements on why they have never used health apps that allow you to track your diet (*N*=567)**

Most (83.25%, *n*=825) of the participants believed that monitoring food intake aids in improving dietary intake and overall wellness. When asked how important they considered dietary tracking in this context, 41.57% (*n*=412) considered it very important, and 45.11% (*n*=447) considered it slightly important. The remaining participants found tracking to be less important in the improvement of dietary intake and overall wellness: not very important by 11.40% (*n*=113) or not important at all by 1.92% (*n*=19) of participants. No association was found between gender and the belief that monitoring food intake will aid in improving dietary intake and overall wellness (Pearson Chi^2=0.08, *p*=0.779). Similarly, gender was not significantly associated to the level of importance given to dietary tracking (very important, slightly important, not very important, not important at all) when the goal is improvement of dietary intake and overall wellness (Pearson Chi^2=4.06, *p*=0.225).

4.1.4 Comparison of demographic characteristics with awareness, use and purchase of mobile health applications

A variety of demographic characteristics (gender, language, study year, accommodation) were analysed in conjunction with data on mobile health app use, including (a) whether participants were aware of health apps (Table 4.3), (b) whether they had used health apps in the past (Table 4.4), and (c) whether they have paid for health apps (Table 4.5).

Females (81.16%, n=530) and males (75.74%, n=256) were similarly aware of health apps that track dietary intake. Females (49.92%, n=326) used these health apps more than males (28.99%, n=98), whereas males (8.16%, n=8) were more likely to pay for health apps than females (2.46%, n=8).

Afrikaans (82.53%, n=307) and English (82.30%, n=400) speakers were most aware of health apps that track dietary intake; however less than half of Afrikaans (46.51%, n=173) and English (44.44%, n=216) speakers had used these apps in the past, and very few (2.89%, n=5 Afrikaans, 2.31%, n=5 English) have paid for health apps. Speakers of Sesotho (70%, n=7), Setswana (70%, n=7), isiZulu (68.42%, n=13), Xitsonga (66.67%, n=2) and other languages (64.71%, n=22 includes Arabic, Dutch, French, German, Hebrew, Korean, Mandarin Chinese, Polish, Portuguese, Shona, Swahili, and Turkish) were also mostly aware of health apps, although few had used these apps in the past (Table 4.4). Half (50%, n=1) of isiNdebele speakers have used health apps previously, and 100% (n=1) have paid for a health app.

Table 4.3: Analyses of health app awareness and demographic characteristics (*N*=991)

Gender (Pearson Chi² = 4.042, p = 0.044)	No		Yes		Total
	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)	Frequency (*n*)
Female	123	18.84	530	81.16	653
Male	82	24.26	256	75.74	338
Language (Pearson Chi² = 80.175, p < 0.001)					
Afrikaans	65	17.47	307	82.53	372
English	86	17.70	400	82.30	486
isiNdebele	2	100.00	0	0.00	2
isiXhosa	16	51.61	15	48.39	31
isiZulu	6	31.58	13	68.42	19
Sesotho sa Leboa (Northern Sotho/Sepedi)	7	58.33	5	41.67	12
Sesotho	3	30.00	7	70.00	10
Setswana	3	30.00	7	70.00	10
siSwati	4	0.00	3	0.00	7

Tshivenda	0	0.00	4	0.00	4
Xitsonga	1	33.33	2	66.67	3
Other	12	35.29	22	64.71	34
Study Year (Fisher´s exact = 0.413)					
1st year	79	23.17	262	76.83	341
2nd year	54	20.22	213	79.78	267
3rd year	40	17.70	186	82.30	226
4th year	25	22.12	88	77.88	113
5th year	5	16.67	25	83.33	30
6th year	1	8.33	11	91.67	12
7th year	1	100.00	0	0	1
Accommodation (Fisher´s exact = 0.040)					
Campus residence	103	24.07	325	75.93	428
Parental home	17	13.60	108	86.40	125
Private accommodation (alone)	17	15.89	90	84.11	107
Private accommodation (sharing)	68	20.54	263	79.46	331

Participants across all study years were similarly aware of health apps that track dietary intake (Table 4.3). Participants with more study years (63.33%, n=19 5th year, 58.33%, n=7 6th year) were more likely to have used health apps previously than those participants in their first year of study (39.30%, n=123 1st year, 40.82%, n=109 2nd year). In this study, participants in their second year of studies (7.41%, n=8) were most likely to have paid for a health app in the past, with those in their fifty year and above being least likely (0.00%, *n=0*).

Participants across accommodation types were similarly aware of health apps that track dietary intake (Table 4.3). Those participants that resided in campus residences were least likely to have used health apps previously (38.32%, *n*=164), and those in private accommodation were most likely (46.73%, *n*=50 alone, 46.22%, *n*=153 sharing). Participants living in their parental home were most likely to have paid for health apps in the past (7.02%, *n*=4), with those residing in shared private accommodation being the least likely (2.61%, *n*=4).

Table 4.4:   Analyses of health app use and demographic characteristics (*N*=991)

Gender (Pearson Chi² = 39.594, *p* < 0.001)	No		Yes		Total
	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)	Frequency (*n*)
Female	327	50.08	326	49.92	653
Male	240	71.01	98	28.99	338
Language (Pearson Chi² = 42.678, *p* = 0.037)					
Afrikaans	199	53.49	173	46.51	372
English	270	55.56	216	44.44	486
isiNdebele	1	50.00	1	50.00	2
isiXhosa	22	70.97	9	29.03	31
isiZulu	14	73.68	5	26.32	19
Sesotho sa Leboa (Northern Sotho/Sepedi)	9	75.00	3	25.00	12
Sesotho	7	70.00	3	30.00	10
Setswana	9	90.00	1	10.00	10
siSwati	7	0.00	0	0.00	7
Tshivenda	4	0.00	0	0.00	4
Xitsonga	2	66.67	1	33.33	3
Other	23	65.71	12	34.29	35
Study Year (Fisher´s exact = 0.064)					
1st year	207	60.70	134	39.30	341
2nd year	158	59.18	109	40.82	267
3rd year	118	52.21	108	47.79	226
4th year	66	58.41	47	41.59	113
5th year	11	36.67	19	63.33	30
6th year	5	41.67	7	58.33	12
7th year	1	100.00	0	0	1
Accommodation (Fisher´s exact = 0.100)					
Campus residence	264	61.68	164	38.32	428
Parental home	68	54.40	57	45.60	125
Private accommodation (alone)	57	53.27	50	46.73	107
Private accommodation (sharing)	178	53.78	153	46.22	331

Table 4.5:   **Analyses of health app purchase and demographic characteristics (*N*=423)**

Gender (Pearson Chi² = 6.726, *p* = 0.010)	No		Yes		Total
	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)	Frequency (*n*)
Female	317	97.54	8	2.46	325
Male	90	91.84	8	8.16	98
Language (Fisher´s exact = 0.002)					
Afrikaans	168	97.11	5	2.89	173
English	211	97.69	5	2.31	216
isiNdebele	0	0.00	1	100.00	1
isiXhosa	6	66.67	3	33.33	9
isiZulu	5	100.00	0	0.00	5
Sesotho sa Leboa (Northern Sotho/Sepedi)	2	66.67	1	33.33	3
Sesotho	3	100.00	0	0.00	3
Setswana	1	100.00	0	0.00	1
siSwati	0	0.00	0	0.00	0
Tshivenda	0	0.00	0	0.00	0
Xitsonga	1	100.00	0	0.00	1
Other	10	90.91	1	9.09	11
Study Year (Fisher´s exact = 0.397)					
1st year	130	97.74	3	2.26	133
2nd year	100	92.59	8	7.41	108
3rd year	105	97.22	3	2.78	108
4th year	45	95.74	2	4.26	47
5th year	19	100.00	0	0.00	19
6th year	7	100.00	0	0.00	7
7th year	0	0.00	0	0	0
Accommodation (Fisher´s exact = 0.527)					
Campus residence	157	96.32	6	3.68	163
Parental home	53	92.98	4	7.02	57
Private accommodation (alone)	48	96.00	2	4.00	50
Private accommodation (sharing)	149	97.39	4	2.61	153

4.2   PHASE 2

4.2.1   Demographic data

The demographics of the Phase 2 pilot study population are summarised in Table 4.6. Of the 61 participants, 75.41% (*n*=46) were females and 24.59% (*n*=15) males. Regarding race, more than half (73.77%, *n*=45) of the participants indicated that they are white, with 16.39% (*n*=10) black, 4.92% (*n*=3) coloured, and 4.92% (*n*=43) Asian/Indian participants. The majority of participants were Afrikaans (44.26%, *n*=27), English (42.62%, *n*=26)

and isiXhosa (6.56%, *n*=4) speakers, and lived either in campus residences (44.26%, *n*=27) or were sharing private accommodation (36.07%, *n*=22) at the time of the study, with fewer participants living in their parental home (9.84%, *n*=6) or alone in private accommodation (9.84%, *n*=6).

Most of the participants were in their early years of study: 31.15% (*n*=19) in their first year, 29.51% (*n*=18) in their second year, and 22.95% (*n*=14) in their third year.

Table 4.6   **Phase 2 Respondent Demographics (*N*=61)**

Demographic characteristic	Frequency (*n*)	Percentage (%)
Gender		
Female	46	75.41
Male	15	24.59
Race		
African	10	16.39
Mixed ancestry	3	4.92
Asian or Indian	3	4.92
Caucasian	45	73.77
Home Language		
Afrikaans	27	44.26
English	26	42.62
IsiXhosa	4	6.56
isiZulu	1	1.64
Sesotho	1	1.64
SiSwati	1	1.64
German	1	1.64
Accommodation Type		
Campus residence	27	44.26
Parental home	6	9.84
Private accommodation (alone)	6	9.84
Private accommodation (sharing)	22	36.07
Unknown	4	6.56
Year of Studies		
1st year	19	31.15
2nd year	18	29.51
3rd year	14	22.95
4th year	7	11.48
5th year	1	1.64
6th year	2	3.28

4.2.2 The usability and perceived efficacy of MyFitnessPal in changing dietary choices

Participants could strongly disagree, disagree, agree, or strongly agree with a series of statements regarding the usability and perceived efficacy of the MyFitnessPal mobile health app. Results are presented in Table 4.7 and Table 4.8.

The majority of participants found MyFitnessPal easy to use (52.46%, *n*=32 strongly agreed, 40.98%, *n*=25 agreed) and did not experience difficulties in setting up a user profile (50.82%, *n*=31 strongly disagreed, 44.26%, *n*=27 disagreed with the survey statement) or in-app personal goals (42.62%, *n*=26 strongly disagreed, 50.82%, *n*=31 disagreed with the survey statement). Participants did experience difficulties in knowing which food or drink items to select from the MyFitnessPal food product database (4.92%, *n*=3 strongly agreed, 34.43%, *n*=21 agreed with the survey statement) and adding the correct portion sizes to the selected food items in the Food Diary (14.75%, *n*=9 strongly agreed, 49.18%, *n*=30 agreed). Most participants indicated that they understood the nutritional information presented in the app (40.98%, *n*=25 strongly agreed, 47.54%, *n*=29 agreed).

Most of participants believed that they understood the in-app breakdown of their energy, nutrient, and macronutrient intake, and that seeing the breakdown was helpful in improving their food choices and dietary routine. Most also indicated that they changed their food intake in order to meet their energy, specific nutrient and macronutrient goals. Breakdown of results is presented in Table 4.8.

The majority of participants indicated that MyFitnessPal helped them to make dietary changes (47.54%, *n*=29 strongly agreed, 44.26%, *n*=27 agreed with the survey statement), and that they learned something new about achieving a healthy diet and lifestyle by using the app (47.54%, *n*=29 strongly agreed, 42.62%, *n*=26 agreed with the survey statement).

Table 4.7: Survey Questions on the Usability of MyFitnessPal (*N*=61)

	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)
	Strongly Disagree		Disagree		Agree		Strongly Agree	
GENERAL EASE OF USE								
• The MyFitnessPal mobile application is simple and easy to use	1	1.64	3	4.92	25	40.98	32	52.46
PROFILE AND GOALS SETUP								
• I experienced difficulties in setting up my MyFitnessPal user profile in the app	31	50.82	27	44.26	2	3.28	1	1.64
• I experienced difficulties in setting personal goals in the app	26	42.62	31	50.82	4	6.56	0	0.00
USE OF THE FOOD DIARY								
• I experienced difficulties in knowing which food or drink item to select from the list	11	18.03	26	42.62	21	34.43	3	4.92
• I experienced difficulties in adding food or drink items to my MyFitnessPal Food Diary	20	32.79	29	47.54	11	18.03	1	1.64
• I experienced difficulties in adding the correct portion sizes to my Food Diary	6	9.84	16	26.23	30	49.18	9	14.75
• I experienced difficulties in adding food or drink items using the barcode scanner	20	32.79	26	42.62	8	13.11	7	11.48
• I experienced difficulties in adding new food or drink items (creating my own recipes, meals and foods)	13	21.31	29	47.54	14	22.95	5	8.20
NUTRITIONAL INFORMATION								
• The nutritional information was presented in the app (in tables, charts and graphs) in a meaningful way that I could understand	0	0.00	7	11.48	29	47.54	25	40.98

Table 4.8: Survey Questions on the Efficacy of MyFitnessPal (*N*=61)

	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)	Frequency (*n*)	Percentage (%)
	Strongly Disagree		Disagree		Agree		Strongly Agree	
AWARENESS OF DIETARY HABITS								
• Becoming aware of my food choices by tracking my diet (using the app) will help to improve my health	0	0.00	1	1.64	28	45.90	32	52.46
IN-APP NUTRITIONAL INFORMATION								
• I understood the information on the breakdown of the energy (or kilojoule) content of my meals	0	0.00	5	8.20	23	37.70	33	54.10
• Seeing the breakdown of the energy (or kilojoule) content of my meals, in a pie chart, was helpful in improving my food choices and dietary routine	0	0.00	13	21.31	30	49.18	18	29.51
• I understood the information on the breakdown of my nutrient intake	0	0.00	3	4.92	27	44.26	31	50.82
• Seeing the breakdown of my nutrient intake, in table format, was helpful in improving my food choices and dietary routine	0	0.00	6	9.84	33	54.10	22	36.07
• I understood the information on the breakdown of my macronutrient distribution or macros	0	0.00	5	8.20	23	37.70	33	54.10
• Seeing the breakdown of my macronutrient distribution or macros, in a pie chart, was helpful in improving my food choices and dietary routine	0	0.00	10	16.39	28	45.90	23	37.70

DIETARY CHANGES

• It was easy to improve my food choices and dietary routine, based on the information I gained from using the app	1	1.64	9	14.75	29	47.54	22	36.07
• I changed my food intake in order to meet my goal energy (or kilojoule) intake	1	1.64	9	14.75	27	44.26	24	39.34
• I changed my food intake in order to meet certain nutrient goals	3	4.92	17	27.87	21	34.43	20	32.79
• I changed my food intake in order to meet my macronutrient distribution or macros goals	1	1.64	19	31.15	24	39.34	17	27.87
• Using MyFitnessPal helped me to make dietary changes	0	0.00	5	8.20	27	44.26	29	47.54
• I have learned something new about achieving a healthy diet and lifestyle by using MyFitnessPal	1	1.64	5	8.20	26	42.62	29	47.54

Weight goals were set by 85.25% (*n*=52) and fitness goals set by 47.54% (*n*=29) of participants. The majority of participants indicated that they set a weight goal in order to lose weight (75.41%, *n*=46). The remaining participants indicated that they set weight goals in order for weight maintenance (18.03%, *n*=11), or weight gain (6.56%, *n*=4).

Participants were asked to provide a self-reported weight, after the period of using MyFitnessPal. This post-MyFitnessPal weight was analysed in accordance with the weight goal that the participants used to set up their MyFitnessPal profile. Good concordance was found with a difference of 1.282kg (95% CI=-11.3-13.9), depicted in Figure 4.7.
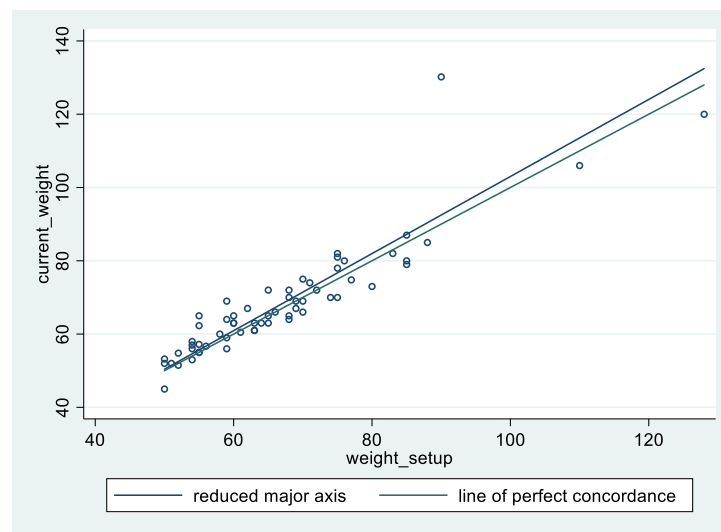

Figure 4.7: **Concordance analysis of participant weight used to setup MyFitnessPal profile versus self-reported weight post-MyFitnessPal use (*N*=61)**

Observations of participant self-reported weight, before and after the period where the MyFitnessPal app was used, indicate no statistically significant difference in weight (*p*=0.420). An average weight loss of 0.912kg was reported (95% CI=-1.3–3.2). Results show that the group of participants that indicated they wanted to lose 5kg or more lost a significant amount of weight, an average of 1.9kg (95% CI=-3.54–0.32, *p*=0.104); however the aim of 5kg or more was over ambitious. Those participants that wanted to lose some weight (1–5kg) did not show a significant loss of weight; in fact their average weight increased by 0.48kg (95% CI=-0.64–1.61, *p*=0.810), and the group of participants that wanted to gain some weight did not show a significant increase in weight (95%CI=-3.60–13.93, *p*=0.095).

The majority of participants thought that the energy goal recommended by MyFitnessPal was just right (54.10%, *n*=33), 24.59% (*n*=15) thought the recommended energy goal was too high, 4.92% (*n*=3) thought it was too low, and 16.39% (*n*=10) were not sure. Most of the participants (65.57%, *n*=40) indicated that they did not change the recommended energy goal after setting their profile.

Most of the participants felt that using MyFitnessPal helped them to achieve the goals that they set (65.57%, *n*=40), with some participants unsure (27.87%, *n*=17).

The majority of participants did not make use of the community feature of MyFitnessPal (91.80%, *n*=56). Of the 8.20% (*n*=5) of participants that did use the community feature, 80% (*n*=4) indicated that the feature helped them to stay motivated to continue to improve their diet.

Most of the participants strongly agreed (67.21%, *n*=41) or agreed (16.39%, *n*=10) with the statement, 'I prefer using an app like MyFitnessPal to record my diet, compared with pen and paper.'

Figure 4.8 demonstrates the frequency of use of MyFitnessPal during the three-week study usage period. The majority of participants used the app more than once per day (32.79%, *n*=20), at least once per day (22.95%, *n*=14) or at least five times per week (21.31%, *n*=13). Almost half (44.26%, *n*=27) of the participants indicated that they used the app less as the weeks passed, and 72.13% (*n*=44) indicated that they thought they would continue using the app after the study had ended.
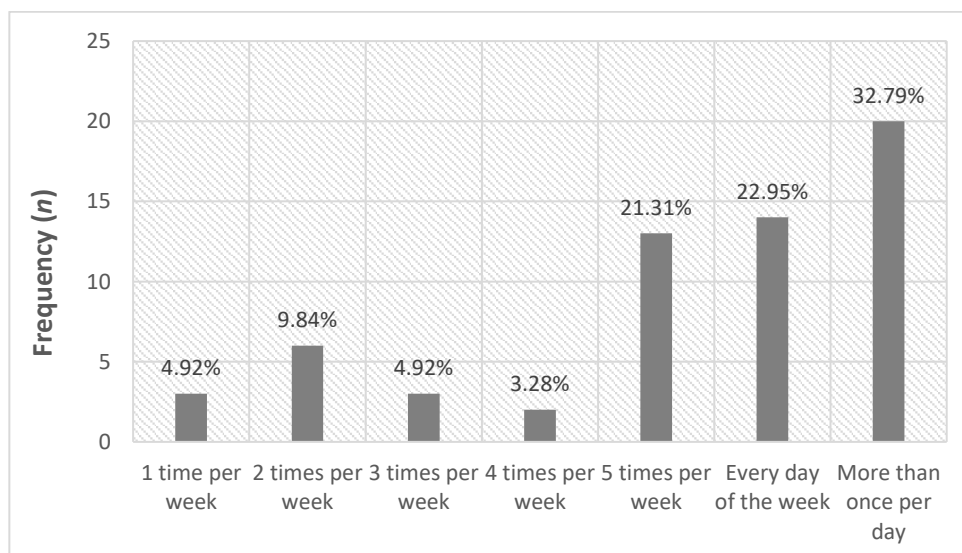

**Figure 4.8:** **Participant frequency of use of MyFitnessPal during the three-week study period (*N*=61)**

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The majority of participants (55.74%, *n*=34) indicated that they did not use MyFitnessPal less and less as the study period went by, with 72.13% (*n*=44) reporting that they would continue using the app after the study period had ended. Those participants who indicated that they would not continue using the app (27.87%, *n*=17) were asked to provide reasons: 64.71% (*n*=11) found it tedious to use, 35.29% (*n*=6) did not have time to use it, and 11.76% (*n*=2) did not find it useful and did not want help to improve their diet. Other reasons were provided by 29.41% (*n*=5) of participants, of which the most notable reason provided was related to psychological, over-controlling or obsession-related behaviour with regard to food (11.76*%, n*=2).

Participants were asked whether they felt that MyFitnessPal missed any features that would have helped them to improve their food choices and dietary routine: 31.82% (*n*=21) indicated that they did not need any additional features, 13.64% (*n*=9) indicated that they would like to see healthy meal and snack or healthy meal plan suggestions, 10.61% (*n*=7) wanted to see more variety in the diet information available on the app, and 10.61% (*n*=7) wanted a more detailed individualised approach, such as the app recognising the users' common dietary issues and basing recommendations on this information. Country-specific food items and suggestions (9.09%, *n*=6) and simpler portion size-related features such as portion-size entry, calculation and unit conversion (3.03%, *n*=2) were also proposed as features. Other features (24.24%, *n*=16) suggested were notifications about current intake such as reminders to increase the intake of certain nutrients, a more detailed breakdown of nutrients, a feature that tracks body measurements such as waist and hip circumference, and working with local supermarket chains in order to inform users of where to find the best prices for food items.

4.2.3   Comparison of dietary intake data before and after the use of MyFitnessPal

Comparison data of mean adapted DINE scores before and after the use of MyFitnessPal for the different DINE food groups are represented in Table 4.9 and Figure 4.9(a-c). A significant difference in intake was found for the Sugary Foods group, with a mean difference of 0.5 score units (CI=0.70–1.01, *p*=0.030). No significant difference in intake was found for either the Fatty Foods or the Fruit and Vegetables groups. Mean consumption of the Fruit and Vegetables group was nearly identical before and after the use of MyFitnessPal, and mean consumption of Fatty Foods increased slightly (Figure 4.9, Table 4.9).
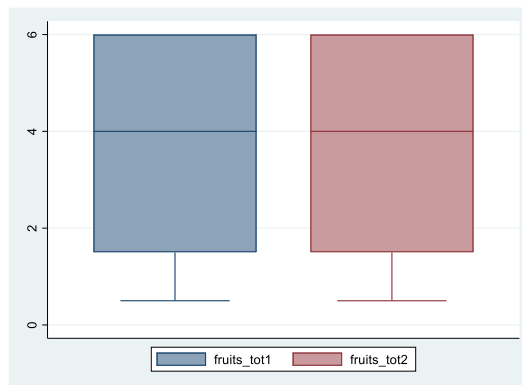
4.9 a)
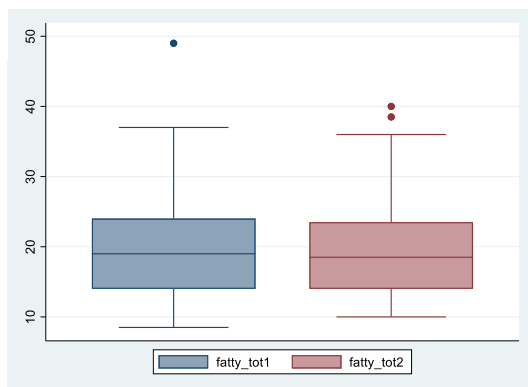
4.9 b)
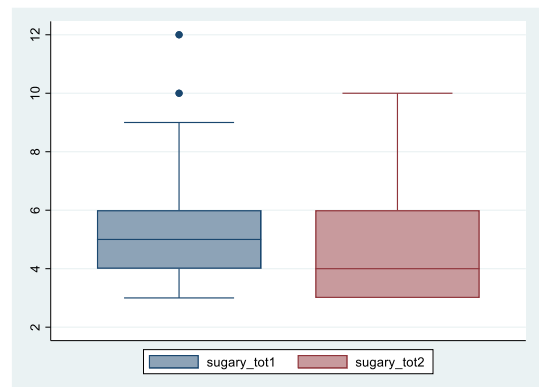
4.9 c)

Figure 4.9: **Comparative analysis for the DINE tool for food groups (a) fatty foods, (b) sugary foods, and (c) fruit and vegetables, before (tot1) and after (tot2) use of MyFitnessPal (*N*=61)**

Table 4.9: DINE comparison before and after use of MyFitnessPal

DINE Food Group	Before use of MyFitnessPal			After use of MyFitnessPal			Mean Difference between before & after use				
	Mean	Std Error	95% CI	Mean	Std Error	95% CI	Mean	Std Error	SD	95% CI	p
Fatty Foods	19.86	1.01	17.83-21.89	19.98	0.99	18.01-21.96	0.12	1.09	8.48	-2.30-2.05	0.91
Sugary Foods	5.34	0.24	4.87-5.82	4.80	0.22	4.36-5.25	0.54	0.24	1.84	0.70-1.01	0.03
Fruit & Vegetables	3.70	0.24	3.22-4.18	3.69	0.23	3.23-4.14	0.01	0.27	2.12	-0.53-0.55	0.98

* CI = Confidence Interval
SD = Standard Deviation

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CHAPTER 5: DISCUSSION

Many people find it difficult to control their own health. Current technological advances such as mHealth apps, for example, those that help to track and analyse dietary intake, can promote a healthy lifestyle while encouraging and providing instruction on healthy eating and lifestyle behaviour. (97) They may also promote compliance and empower individuals to meet their personal health and wellness goals. (46)

The population for the first phase of this study comprised 991 undergraduate university students between the ages of 18 and 25, of whom more than half of participants were female. The majority of participants were English or Afrikaans speakers, and resided in campus residences. Most survey responses were received from students in their first year of studies, followed by responses from second- and third-year students.

The majority of participants believed that they consumed a healthy diet and reported that most of their meals were homemade and consumed at home. These results are in stark contrast to the well-documented unhealthy dietary habits of the student population in South Africa and globally, as described in the overview of the literature. (10) Despite most of their self-reported weight and height values falling within the healthy BMI category, most participants reported wanting to lose weight to some degree. It should be noted that self-reported weight and height are often inaccurate; it has been shown that men and women both tend to overestimate height, and those (women and men) who are heavier tend to underestimate weight. (120). It may be possible that self-reported weight and height values in this study are not a true reflection of the actual measurements of the participants. However, it is known that individuals, especially females, who have a normal weight usually also desire to lose some weight, even if it is not a significant amount. (121)

Research has shown that the perception of being overweight is positively associated with attempts to control weight (122); however perceived weight does not often agree with actual weight, also in the case of self-reported values. (123) Some of these findings are reflected in this study where a significant positive association was found between BMI (from self-reported weight data) and having the will to improve dietary intake in order to improve their weight. Although most participants did search actively for information on how to improve their diet, BMI was not statistically associated with this search for information. Thus, those participants with BMIs in the overweight or obese categories were also the groups of participants that indicated the will to improve their diet most; however even though they did search for health information in order to do so, they were not the groups that searched the most. It should be taken into account that searching for information does not necessarily translate to action. Lack of motivation may play a role in advancing from will to action. (124,125) Motivation plays an essential role in successful weight loss and weight maintenance (126).

5.1   THE NEED FOR MOBILE HEALTH APPLICATIONS TO SERVE AS DIETARY ASSESSMENT TOOLS FOR WELLNESS PURPOSES

Most of the participants in this study wanted to improve their diet for weight and/or health purposes, and actively searched for information on how to accomplish this, as mentioned above. Those participants that believed they consumed a healthy diet in general were the group that also most actively searched for this information. Electronic media was the most popular source of this information, in accordance with literature that reports young adults´ affinity for current technology such as the Internet and social media. (14) Almost all participants owned a mobile phone. The correct health information, such as that received from a trained healthcare professional, is a helpful tool when the goal is to make positive changes in health behaviour. It is possible that the health literacy of a proportion of this student population (specifically medicine and health science students, including students in nutrition), i.e. the ability to find health information and assess its content or level of usefulness for a specific health issue, (42) is more advanced than that of the average population. Consequently, it may be that searches in this population provide more accurate health information, and thus a higher potential for positive health behaviour changes than in the average individual with lower health literacy who may not know where to find quality health information. Although online nutrition misinformation is rife, it is possible to find high-quality health and nutrition information that may be helpful to optimise an individual´s diet. However, the heuristic processing of online information by users has been assessed and reported on in literature, with users relying on search engine rankings as a representation of the credibility of online health information. (127) Online user ranking does not necessarily signify the use and sharing of quality information. One systematic review (2017), exploring the use of electronically delivered (the Internet and social media) health promotion messages for diet, physical activity and smoking, found insufficient quality evidence that health promotion delivered through social media leads to improved health behaviours. The study further reports that social media does not produce an important benefit in terms of health promotion; however there is a need for more high-quality studies in the area. (128)

5.2   THE PERCEPTION OF MOBILE HEALTH APPLICATIONS TO SERVE AS DIETARY ASSESSMENT TOOLS FOR WELLNESS PURPOSES

Those participants who actively searched for information on health and diet also tended to make use of diet-tracking apps. When considering frequency of use, the majority of participants indicated that they either used diet-tracking apps every day, a few times per week, or a few times and then never again. Most participants believed that monitoring or tracking food intake plays a role in the improvement of overall

dietary intake and wellness. Previous studies have reported on dietary self-monitoring adherence issues, such as low adherence and decreased use over time. Using mobile apps in comparison with the traditional paper-and-pen method may be beneficial in improving self-monitoring adherence, although available studies mostly have small sample sizes, therefore more high-quality data would be valuable. (32,129) Mention of the lack of user motivation or willingness to use diet-tracking health apps on a regular basis has been reported in the literature. (113)

Most participants heard about health apps with the ability to track diet through electronic media, such as the Internet and social media. Health professionals were reported as a source by some of the participants. The use of mobile health apps in dietetic practice, for example, has been assessed previously, revealing their increasing infiltration in the area. (111,130,131)

In this study, the most popular reasons provided for never having used diet-tracking health apps were not having time, not trusting that the apps accurately analyse the diet, merely not being interested in them and not wanting to spend mobile data on them. Participant reservations relate to reports from previous studies. Common reservations as discussed in the literature exist regarding content quality (accuracy of nutritional analyses and information), usability issues (food and portion size selection issues), and cost. (111,130,131) Participants from a 2017 study mentioned a dislike of the focus on calorie counting when using nutrition-related apps and found these types of apps to be too complex, while also malfunctioning at times. (132) In another study (2018) on the experiences and perceptions of adults on nutrition apps, some participants found recording dietary intake time-consuming and difficult and were unsure of the accuracy of food databases on the apps. The study also notes that adherence was affected by user situation, which included time availability and schedule. (102) Mobile apps that track dietary intake generally offer the user a simplified version of the traditional dietary recording process, in what is aimed to be a user-friendly format. In order to simplify the process even further, some app developers have introduced new methods to record the food that is eaten, for example, by the user only having to take a photo of the meal with the app doing the rest of the work. These methods, however, are still being verified in tests. (133)

In the assessment of the nutritional calculation analysis of five popular diet-tracking apps (MyFitnessPal, Fitbit, Lose It!, MyPlate and Lifesum), it was found that these apps tend to underestimate nutritional intake for most nutrients, while the comparative validity of energy and other macronutrients (total carbohydrate, protein, and fat) were slightly more accurate. There is a common tendency to underestimate food and nutrient intake when self-reporting, therefore this added underestimation in intake analysis can be concerning. (134) Furthermore, it has been found that popular smartphone apps, in particular those featured under the category of 'Health and Fitness' in the Google Play and iTunes app store, demonstrate poor adherence to evidence-based dietary guidelines (2015–2020 Dietary Guidelines for Americans). Partial

adherence by most apps was found for five components of healthy eating (healthy eating pattern, appropriate energy limits, nutrient-dense foods and drinks, variety in intake of food and drinks, and community outreach or social support), with low adherence for daily food group and subgroup intake amounts. (135) Undoubtedly the current literature suggests that consumer distrust in nutrition app accuracy exists, which concurs with reports from studies showing that apps in this area are often inaccurate and may not be based on, or promote, evidence-based information, as mentioned above.

MyFitnessPal was the most popular diet-tracking health app that participants in this study had used in the past. It has been found to be most popular in various studies and reports on mobile health apps. (53,99,102) Other popular apps mentioned in this study included MyFoodDiary, Samsung Health, and Lose It!. The MyFoodDiary website mentions that the aim is to improve the food diary experience by ensuring the 'food database is curated by trained staff to avoid errors, missing nutrition data, and duplicates that plague other food diary services'. The mobile app is available to members of the MyFoodDiary website at no cost. Membership of MyFoodDiary is paid. (136) The Samsung Health app is freely available on both Android and iOS platforms. At the time of the study it had more than 500 million downloads on the Android Play Store. Download data for the Apple iStore was not available. The Samsung Health app can track activity, dietary intake, heart rate, stress data and sleep, and provides insights based on tracked data to help users reach their goals. The app can also connect the user to online medical professionals such as doctors and dietitians. (137) Lose It! Calorie Counter is a freely available app on both Android and iOS platforms. It has similar features to conventional diet-tracking apps, where users may set goals and track dietary intake and exercise, together with a community platform. Unique features include the ability to take pictures of food ('snap it' beta) as a method of entering food items into the food diary, and the incorporation of a nutrigenomic feature (embodyDNA), where users may send a saliva sample via mail and receive their results and personalised dietary 'DNA suggestions' through the app. (133) It had more than 10 million downloads on the Android Play Store at the time of the study. Of the most popular apps mentioned in this study that track diet, all have unique features: MyFitnessPal is free to download and has a large database, MyFoodDiary is paid and has a database curated by trained staff, Samsung Health tracks heart rate, stress data and sleep, aside from diet, and Lose It! Calorie Counter is free and incorporates new technology such as nutrigenomics and the ability to capture food intake data with a phone camera.

Overall, despite the majority of participants in this study believing that they consume a healthy diet and reporting weight values that fall within the healthy BMI category, most participants indicated the will to improve their diet for both health and weight purposes and actively searched for information on how to

accomplish this, mainly through use of electronic media. MyFitnessPal was cited as the most popular health app previously used by participants in this study.

5.3 COMPARISON OF DEMOGRAPHIC CHARACTERISTICS WITH AWARENESS, USE AND PURCHASES OF MOBILE HEALTH APPLICATIONS

In considering the total study population, while the majority of participants were aware of these types of mobile health apps, less than half had ever made use of them, very few had ever paid for them, and most were not willing to pay. A slightly larger proportion of females were aware of these apps than males, and females also reported having used them previously more than males, although males were more likely to have paid for them. This correlates with a 2017 study that found women are more likely to use these platforms, use them more frequently and tend to engage in more depth, such as sharing content or making comments. (138) In the current study, Afrikaans and English speakers were more aware of diet-tracking apps compared with speakers of other languages; however less than half of Afrikaans and English speakers have ever used these apps in the past.

5.4 MYFITNESSPAL USABILITY AND PERCEIVED EFFICACY IN CHANGING DIETARY CHOICES

Research on mobile health apps is still in its infancy. Consequently at present there are various challenges in the assessment of mobile health app quality, and not an abundance of research to draw from in order to address several of them. A proposed multi-dimensional framework for assessing health app quality describes usability, one of six assessment areas, as how well the app engages the user. This refers to the quality of the user interface, with attention to usability testing, user satisfaction reports, user engagement, and literacy level adequacy. (139) The researcher aimed to assess the usability of the MyFitnessPal mobile app by means of a pilot study, also addressing whether users perceived the app to be effective in changing their dietary choices.

The participants in this pilot study found MyFitnessPal simple and easy to use, experiencing minimal technical difficulties in setting up in-app profiles or personal goals. Some difficulties were indicated in the selection of food and beverage items to be added to the in-app food diary. This concurs with results from other studies and reviews on the MyFitnessPal app, mentioned in the evaluation of existing literature, where users indicated difficulties with food item matching. Users from one study (2013) mentioned that MyFitnessPal required too much detail when recording food intake. (107,113,131) Since the release of the MyFitnessPal

mobile app, update files for new versions have been available continuously. Consequently, the version of the app that was available at the time of the previously mentioned study (2013), before MyFitnessPal was sold to Under Armour in 2015, may have had a less user-friendly food-recording process to the version of the app that was available around the time of this study (2018). This could explain why an overly detailed food-recording process was not noted as a difficulty by participants in the current study. One small study reported that participants tended to pick apps with larger food databases; however difficulties in identifying the correct food items from the numerous available options were reported. (102) In this study, participants did not experience major complications in adding food items to the food diary, although some participants indicated that they experienced problems in using the barcode scanner. The usability of the barcode scanner depends on the completeness of the food database, which often contains country-specific food items. (140) MyFitnessPal (based in the US) is an internationally available app and the food database is based on user input, thus there are country-specific food items from various countries available in the database. Their accuracy, however, cannot be ascertained except in the case where food items have been verified (a green in-app tick mark). (141) Barcode scanning issues in this study could have arisen owing to a limited representation of South African food products in the MyFitnessPal food database. Some difficulties were also experienced in adding the correct portion sizes to food items, and creating own food or drink items in the app, in line with previous studies where these have also been described as key challenges. (102,113)

Most participants used the MyFitnessPal app multiple times per day, once per day, or at least five times per week. Less than half of the participants indicated they used MyFitnessPal less as the weeks passed, and the rest indicated consistent use throughout the study period. Results could have been influenced by the Hawthorne effect (142), and may not be a reflection of how they would use it in everyday life. Concrete data on the download and use of MyFitnessPal by the participants of this study was not available to the researcher, but would be able to demonstrate more accurately how often users logged in to the app on a daily basis during the time of the study. One study (2017) found that drive for thinness was a predictor of usage frequency of apps for healthy eating, maintaining a diet and losing weight. (113) Although the majority of participants in this pilot study believed that tracking their diet using MyFitnessPal would improve their health, the fear (and experience of) increased obsession and disordered behaviour around food when using diet-tracking apps was mentioned by some participants. This risk of obsession in those at a risk for developing eating disorders has been mentioned by various previous studies. (107,143,144) Participants in a 2017 study noted obsessive feelings with regard to diet and exercise, anxiety or guilt feelings when food intake or exercise goals were not met, neurosis about their body image, and interference with their daily activities and social life. (144) In contrast, Jospe et al. 2018, reported no evidence of increased eating disorders. (108) The subject of possible mental health consequences associated with health app use in an already vulnerable

group may be of concern. More research focused on mental health issues in app users could provide valuable insights.

In-app weight goals were set by most participants, while almost half set fitness goals. The majority of participants´ weight goals were set to lose weight, and about one-fifth had the goal of weight maintenance. A few also had the goal of weight gain. In-app weight goals and self-reported actual weight after using the app were consistent, with an average difference of 1.282kg between the goal and the self-reported actual weight. Most participants said they felt MyFitnessPal helped them to achieve the goals they set. A descriptive study assessing desirable mHealth app features from a user perspective (*n*=519 university students) found goal setting to be an important tracking and personalisation feature. (46) Participants in another study noted that goals either served as self-motivating, as progress to meet the goals was still necessary, whereas others mentioned decreased motivation when poor progress was made towards achieving set goals. (102) Literature supports self-reflection on progress towards achieving goals that are related to health behaviours, as it may contribute to ongoing engagement with these health behaviours. (145,146)

In respect of literacy level, most participants indicated that they understood the nutritional information, energy breakdown, nutrient breakdown, and information on macronutrient distribution provided by MyFitnessPal. With the study population being university students and with students of nutrition not excluded, the level of education may explain the fact that the majority of participants understood the nutritional information displayed in the app. In addition, other possible reasons include the nutritional information is broken down and displayed in a simplified way; an energy breakdown per meal (%, kJ), graphically displayed in a pie-chart (breakfast, lunch, dinner, snacks); a breakdown of nutrient intake for certain macro- and micronutrients (Table 2.4) displaying the total intake and goal intake for each nutrient; and a breakdown of macronutrients carbohydrates, protein and fat (%), also displayed in a pie chart. Most of the participants found the pie chart of their energy breakdown, as well as the table with nutrient breakdown, useful in improving their food choices and dietary routine. More than half of the participants agreed with the energy goal provided by MyFitnessPal, with just less than a quarter believing it was too high. The majority, however, did not change their energy goals.

 Most of the participants changed their food intake to meet the in-app energy, macronutrient distribution and other specific nutrient goals. Data from this pilot study reveals that most participants focused on the energy component of their diet, with less focus on nutrients and the least focus on macronutrient distribution. In order to ensure the intake of a healthy, balanced diet, and to decrease risk of overweight, obesity and the long-term development of NCDs, focus should be on both nutritional quantity and quality, i.e. total energy intake, together with macronutrient and other nutrient distribution and intake.

Very few participants made use of the community feature, but most of those who did indicated that it helped them to stay motivated and continue to improve their diet. The majority of participants indicated that they preferred using an app like MyFitnessPal to track their dietary intake instead of the traditional paper-and-pen method. A 2016 study (*n*=24) reported that the assistance that individuals actually desire in weight-management self-help tools is motivational and autonomous e-support together with goal-setting and reviewing, and not necessarily the commercially available tools such as dietary self-monitoring. (132) The community feature of MyFitnessPal serves as an area of communication, support and motivation between users. Conversations and topics are user driven, with no advice from health professionals available on this platform, therefore shared information is not controlled or checked for accuracy. There are rules for using the platform, including not promoting very low-calorie diets, for example; however, the sharing of nutritional misinformation is prevalent. (106) In the previously mentioned study, researchers supported the development of more effective electronic, theory-driven and motivational self-help interventions. (132)

In this study many participants indicated that MyFitnessPal is functional as is, and does not require any additional features to improve the user experience. Other participants indicated that they could benefit from the app incorporating healthy meal and snack suggestions or healthy meal plans; they also wanted to see more variety on available diet information, and wanted more country-specific food items and suggestions (South African-based population), and simpler portion size entry, calculation and unit conversion. A more detailed individualised approach was also a feature suggested by some participants; however, this might not be possible with an app such as MyFitnessPal. A registered dietitian is trained in the provision of individualised, simplified nutritional information, taking into account behavioural and motivational aspects, and serving as a source of accountability to the client – features hard to find in a health app that is freely available to, and used by, a very large global community. These features, however, are the features that users seem to look for in a diet-tracking health app such as MyFitnessPal, reported in this study and in the available literature.

The majority of participants indicated that they had learned something new about achieving a healthy diet and lifestyle by using the MyFitnessPal app, and that the app helped them to make dietary changes. Most also indicated that they changed their food choices and dietary routine with ease based on the information they gained from using the app. In this study, users gained knowledge and changed their dietary behaviour owing to using MyFitnessPal – both desired outcomes of successful nutrition promotion. Assessing the quality of nutritional knowledge gained from using the app was beyond the scope of this study; however, this would be informative from a public health perspective. It is important to share accurate nutrition information, and a registered dietitian is the trained health professional in this area, as stated above. The previously mentioned 2018 study cautioned against the use of MyFitnessPal without guidance from a dietitian, owing

to what the researchers found to be suboptimal performance in recording food intake due to food omissions, as well as usability difficulties related to the food database and input of accurate portion sizes. (113)

Most of the participants in this study indicated that they would continue to use MyFitnessPal after the end of the study period. Those who would not continue to use the app, cited various reasons, including tediousness of use, lack of time, not finding it useful in improving their diet, and the fear of its use resulting in over controlling food-related behaviour. The positive feedback regarding continuing use of MyFitnessPal after this study is contrary to results found in a 2018 study where only 20% of participants (*n*=43) said that they would continue using MyFitnessPal after the end of the study period, citing similar challenges as previously discussed in estimating portion sizes, choosing the correct food items, and the time-consuming nature of recording food intake, all affecting motivation for long-term use. (113) It should also be taken into account that many participants in the current study may have already used MyFitnessPal in the past, or may have been using it when they agreed to take part in this study, which could have had an effect on the results.

5.5   COMPARISON OF DIETARY INTAKE BEFORE AND AFTER THE USE OF MYFITNESSPAL

In order to assess change in dietary choices, this study made use of an adapted version (147) of the original DINE tool, (119) owing to the original tool's focus on only fats and fibre, and being too intricate for the purpose of the study. The adapted version of the tool does not classify fatty foods, sugary foods and fruit and vegetable intake in terms of percentage of total energy intake, merely stating that high scores indicate high intake, with low scores indicating low intake. (147) For the purpose of this study, the difference in intake of fatty foods, sugary foods and fruit and vegetables before and after use of MyFitnessPal was more important than classifying intake amount in detail.

Baseline scores for sugary foods and fatty foods were on the lower end of the possible range, indicating a low to moderate intake of these food groups within the study population. Intake of fruit and vegetables at baseline was on the higher end of the possible range, indicating moderate to high consumption of this food group. On average, baseline scores indicate a dietary pattern that can be considered healthy, represented by a low to moderate sugar and fat content, and a moderate to high fibre content. The study population as a group indicated the consumption of mostly homemade food, and baseline DINE scores may have been low owing to this fact.

After participants had used MyFitnessPal to track their dietary intake and had taken note of health information provided by the app for a three-week period, sugary foods saw a significant reduction in consumption. The intake of fatty foods was not significantly reduced, and that of fruit and vegetables not

significantly increased. Taking into account that the intake of fatty foods and fruit and vegetables was within healthy ranges at baseline, lack of a significant change in these food groups after use of MyFitnessPal can be considered acceptable. Fruit, vegetables and fat all play significant roles in a healthy, balanced diet. The added sugar in sugary foods, however, when consumed in excess, is considered a nutrient of concern in the public health context, owing to its contribution to an increased risk for the development of chronic diseases. Added sugars contribute to the energy density of the diet, and may promote excess total energy intake. Sugary foods generally do not contain a variety of nutrients, and when eaten regularly may reduce the intake of those foods that are more nutrient dense. This may lead to an overall unhealthy diet, increased weight and an increased risk of developing a range of NCDs, such as type 2 diabetes and CVDs. Reduction in the intake of sugary foods is a global nutrition guideline and goal. (148) In South Africa, for example, a sugar tax was implemented in April 2018 to help curb the excessive sugar intake of the population. The goal is to incentivise consumers to purchase healthier foods, or dis-incentivise them from purchasing less healthy foods, in the battle to reduce diet-related risk factors for NCDs. (149) Various other countries have also implemented similar legislative control mechanisms with the aim to decrease sugar intake. (150)

For the purpose of the study, MyFitnessPal was used by the participants for only a short period of time (three weeks), where less than half of the participants used it on a regular basis. Both factors may have played a role in the magnitude of the effected dietary change and the fact that no significant overall weight difference was found. A significant weight difference and average weight loss of 1.9kg were found for those participants who indicated they wanted to lose more than 5kg. In this study population, these results indicate that those individuals who set higher weight-loss goals tended to lose the most weight. This correlates with previous findings by De Vet et al. (2013) that higher weight-loss goals were associated with more effort by the individual in the attempt to lose weight, as well as higher short-term weight loss. (151) Conversely, general recommendations for weight loss include setting modest goals, (152) although evidence for this recommendation is not conclusive and it has been proposed to recommend the setting of more challenging goals. (151)

Overall in the pilot phase of this study, participants indicated that MyFitnessPal was relatively user friendly, with the exception of a few recurrently appearing usability issues. With regard to effected changes in dietary choices, most participants indicated that they gained nutritional knowledge by using the app, that it helped them to reach their goals, and helped them to make dietary changes. Intake of sugary foods did decrease significantly after using MyFitnessPal; however no significant overall change in self-reported weight was found.

CHAPTER 6: CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

6.1   CONCLUSIONS

This study aimed at exploring the use of mHealth apps as dietary self-monitoring tools for wellness purposes as well as their possible role in the improvement of food choices, in a university population.

Findings demonstrate that a need for diet-tracking mHealth apps exists, with many wanting to lose weight or be healthier and actively looking online for information on how to accomplish this. Mobile health apps such as MyFitnessPal are widely known, used by many, perceived as helpful tools by users, and may play a contributing role by increasing individuals' awareness of their eating habits together with providing information on how to optimise it.

MyFitnessPal was found to be relatively easy to use, with some issues arising in selecting the right food item from the large database and ensuring the correct portion sizes. Users reported that MyFitnessPal helped them to change and improve their dietary intake, and make advancements towards their personal weight and health goals. Baseline dietary intake data for sugar, fruit and vegetables, and fat was within healthy limits; however a significant reduction in sugary food intake was found after the use of MyFitnessPal. This is notable in the context of public health, and falls in line with the introduction of the sugar tax for the very purpose of reducing added sugar intake. No change was found in the intake of fatty foods or fruit and vegetables, and even though average self-reported weight decreased slightly, an overall significant weight change was not recorded. A significant weight loss was however found in the group of participants that indicated that they wanted to lose the most weight (5kg or more). In the context of public health, a decrease in sugar intake and weight through use of a freely available mobile health app, without the guidance of a healthcare professional, may prove beneficial owing to, in particular, its availability and practicality.

6.2   RECOMMENDATIONS

Despite their popularity, there are concerns over the quality of information provided by popular health apps, mentioned by participants in this study, and shown by literature not to be compliant with current evidence-based dietary guidelines. From a wellness perspective, apps that track dietary intake may be useful in creating greater awareness of one's dietary habits. With guidance from a healthcare worker with training in the administration of dietary assessments, accurate recording of dietary intake, and the communication of evidence-based dietary information, their effect on changing and improving dietary behaviour and weight status may be enhanced. Thus, using the app together with a nutrition professional may be valuable in improving app efficacy. A possible added feature could be the in-app promotion of consulting a nutrition

professional when using the app. A similar functioning diet-tracking app constructed based on high-quality, evidence-based information and with the proper guidance, may also be useful in a country-specific, public health and wellness setting.

Health apps that track dietary intake are increasingly studied; however more large, high-quality studies are needed in the area. Recommendations include that future research on nutrition-related mHealth apps pave the way for the development of dietary self-monitoring apps that have a strong evidence base for used and shared nutrition information, and a focus on community support with guidance from nutrition professionals to ensure the sharing of correct information. These apps may play a role in improving public wellness and decrease the cost of healthcare when developed and used as a means to spread accurate mass nutrition and health information. They may also serve as helpful tools in dietetics practice, where they can serve as monitoring tools for the implementation of nutritional advice provided by the dietitian. It is possible in some cases, as it is for MyFitnessPal, for clients to share their food diaries with other users (the dietitian in this case), giving the dietitian the ability to monitor their clients´ dietary intake in real time.

The second phase of this study served as a pilot study for future larger studies aimed at assessing the efficacy of health apps in changing or improving food choices from a public wellness perspective. It is recommended for the researcher to obtain concrete participant app download and usage data from app developers. The use of a dietary intake measurement tool that delivers detailed dietary intake data on specific nutrients of public health concern (such as for example total energy, sugar, sodium, fats, fibre, etc.) could deliver more descriptive dietary data. Periodic dietary intake assessments over an extended period of health app use may deliver valuable information about possible long-term dietary changes. It is recommended to give careful consideration to the psychological aspect of recording dietary data over a period of time, especially in vulnerable individuals where obsessive behaviours may be of concern. More studies in this area are necessary. Participants in this study indicated that they gained nutritional knowledge from using a health app. Deeper investigation into the quality of the nutritional knowledge that is gained from using popular health apps may provide beneficial data.

6.3   LIMITATIONS

The sample is not representative of the study population and results should be interpreted with caution. Limitations of the study include that the study population comprised South African university students with students in nutrition included. Owing to their education level, the general health and nutrition knowledge of this group may be higher than that of the average population, especially in the case of nutrition students. With the study population being South African, it is possible that usability issues may have been related to a

smaller database of South African foods in the MyFitnessPal app. Another limitation is that weight and height data were self-reported and accuracy cannot be verified. For the second phase of the study, errors in height values were particularly notable. It is possible that many participants have used the MyFitnessPal app before participating in this study, which could have influenced results. The researcher was unable to obtain download and usage data from the app representatives. This data was requested to ensure that all participants did indeed download the app, and to obtain usage frequency data subjectively as opposed to the self-reported frequency data that was subsequently used. Due to the researcher not being able to monitor actual download and usage, the results should be interpreted with caution. The MyFitnessPal app was used by participants for a period of three weeks. Data from a more extended usage period may reveal useful long-term information regarding usage frequency and the efficacy of the app in changing dietary choices. Finally, an adapted version of the DINE tool was used to determine app efficacy in changing food choices. The adapted version, as opposed to the full version, does not have concrete ranges representing associated nutrient intake amounts.

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ADDENDA

ADDENDUM A: PHASE 1 SURVEY: THE NEED FOR AND PERCEPTIONS OF MOBILE HEALTH APPS THAT TRACK DIETARY INTAKE

Electronic Survey Assessing the Need For and Perceptions Of Mobile Health Apps that Track Dietary Intake

GENERAL INFORMATION AND CONSENT

You have been invited to take part in a research study entitled: *Mobile health applications in wellness: an assessment of needs, perceptions, usability and efficacy in changing dietary choices.*

Please take some time to read the information presented below, which will explain the details of the study. If you have any queries, please do not hesitate to contact any member of the researcher team (details provided below). Once you have reviewed the general information, please provide consent at the bottom of the page in order to start the survey.

Your participation is entirely voluntary and you are free to decline to participate. You are also free to withdraw from the study at any point, even if you do agree to take part. All the information you provide will be kept private and confidential and will only be used for the purpose of the study.

This study has been approved by the Health Research Ethics Committee at Stellenbosch University (Ref. S17/10/247) and will be conducted according to the ethical guidelines and principles of the International Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is the study about?

This study follows a previous wellness study done on campus, that found students need and want help on improving their diet. This survey forms part of the first (*Phase 1*) of two phases of the study.

In *Phase 1*, we will use a survey to assess :

1) whether there is a need for mobile health applications (apps), with a focus on those that track your diet, as a tool for monitoring and improving your diet, and

2) what the general perception is of these diet-tracking apps. A brief evaluation of demographic characteristics and mobile health app use will also be included.

In the next phase, *Phase 2*, a specific mobile health app (MyFitnessPal) will be assessed, in particular its usability, and whether it helps the user to make healthier food choices.

Why have you been invited to participate?

As a currently registered undergraduate student at Stellenbosch University, between the ages of 18 and 25 years old, you form part of the inclusion criteria of this study.

What will your responsibilities be?

For this phase (*Phase 1*) of the study, your only responsibility will be to complete and submit the online survey, which should take you no more than 10 - 15 minutes. You will be requested to specify your weight (in kilograms) and height (in meters).

Are there any risks involved in your taking part in this study?

No, there are no risks involved.

Will there be any costs involved or payments received for taking part in this study?

No, there are no costs involved in *Phase 1* of this study. You will be entered into a lucky draw, where two participants stand the chance to each win a shopping voucher worth R1000.

In *Phase 2* of the study, there are possible data costs involved in the download and use of the MyFitnessPal app (free version).

Is there anything else you should know or do before you continue with the survey?

By providing consent below, you indicate that you choose to take part in *Phase 1* of this study. After providing consent, you will be able to start the survey.

In the final section of the survey, you may indicate whether you are interested in taking part in *Phase 2*. If you choose to participate, in *Phase 2* you will be requested to:
1) download and use the free version of MyFitnessPal app on your mobile device for a period of 1 month, after which
2) you will be requested to complete a final online survey.

Participation is entirely voluntary and you may choose to withdraw at any time. For this second phase of the study, you will be entered into a lucky draw, where two participants stand the chance to each win a shopping voucher worth R2000.

Participants interested in taking part in *Phase 2* will receive more information in May 2018.

If you have any queries or encounter any problems, you can contact:
Researcher/student: Ms C Slazus RD(SA): +351 911 884 660 or cslazus@gmail.com
Study Leader: Mrs Z Ebrahim RD(SA): (+27) 21 938 9259 or zarina@sun.ac.za
Study Leader: Mrs N Koen RD(SA): (+27) 21 938 9259 or nelene@sun.ac.za
You can contact the Health Research Ethics Committee at (021) 938 9207 if you have any concerns or complains that have not been adequately addressed.

This study and the researchers are in no way affiliated with MyFitnessPal and/or Under Armour, Inc. The material and contents of this study are not promoted, supported or approved by MyFitnessPal and/or Under Armour.

ALGEMENE INLIGTING EN TOESTEMMING

Jy word hiermee genooi om deel te neem aan 'n navorsingstudie getiteld: *Mobile health applications in wellness: an assessment of needs, perceptions, usability and efficacy in changing dietary choices.*

Neem asseblief tyd om die inligting hieronder te lees. Dit sal die besonderhede van die studie verduidelik. As jy enige navrae het, moet asseblief nie huiwer om enige lid van die navorserspan te kontak nie (besonderhede hieronder verskaf). Nadat jy die algemene inligting gelees het, stem asseblief in om deel te neem aan die onderkant van hierdie bladsy, om te begin met die vraelys.

Jou deelname is heeltemal vrywillig. Jy kan ook op enige stadium van die studie onttrek, selfs al stem jy in om deel te neem. Al die inligting wat jy verskaf, sal privaat en

vertroulik gehou word en sal slegs vir die doel van die studie gebruik word.

Hierdie studie is goedgekeur deur die Gesondheidsnavorsingsetiekkomitee aan die Universiteit Stellenbosch (Verw. S17/10/247) en sal uitgevoer word volgens die etiese riglyne en beginsels van die Internasionale Verklaring van Helsinki, Suid-Afrikaanse Riglyne vir Goeie Kliniese Praktyk en die Mediese Navorsingsraad (MRC) Etiese Riglyne vir Navorsing.

Waaroor gaan die studie?

Hierdie studie volg op 'n vorige welweesstudie wat op die kampus gedoen is, wat gevind het dat studente hulp nodig het, en graag wil hê, om hul dieet te verbeter. Hierdie opname vorm deel van die eerste (*Fase 1*) van twee fases van die studie.

In *Fase 1* sal ons, deur middel van 'n vraelys, assesseer:

1) of daar 'n behoefte is aan mobiele gesondheidsprogramme ('apps'), met die fokus op daardie wat jou dieet opneem, as 'n instrument vir die monitering en verbetering van dieet, en

2) wat die algemene persepsie is van hierdie 'apps'. 'n Evaluering van demografiese eienskappe en die gebruik van mobiele gesondheidsprogramme sal ook ingesluit word. In die volgende fase, *Fase 2*, word 'n spesifieke mobiele gesondheids 'app' (MyFitnessPal) geassesseer, veral die bruikbaarheid daarvan, en of dit die gebruiker help om gesonder voedselkeuses te maak.

Hoekom is jy genooi om deel te neem?

As 'n geregistreerde voorgraadse student aan die Universiteit van Stellenbosch, tussen die ouderdomme van 18 en 25 jaar, vorm jy deel van die insluitingskriteria van hierdie studie.

Wat sal jou verantwoordelikhede wees?

Vir hierdie fase (*Fase 1*) van die studie is jou enigste verantwoordelikheid om die aanlyn-opname te voltooi en in te dien, wat jou nie meer as 10-15 minute sal neem nie. Jy word versoek om jou gewig (in kilogram) en lengte (in meter) te spesifiseer.

Is daar enige risiko's betrokke in jou deelname aan hierdie studie?

Nee, daar is geen risiko's betrokke nie.

Is daar enige koste verbonde of sal enige betalings ontvang word met deelname aan hierdie studie?

Nee, daar is geen koste verbonde aan *Fase 1* van hierdie studie nie. Twee deelnemers staan die kans om elkeen 'n inkopiebewys van R1000 te wen.

In *Fase 2* van die studie is daar moontlike datakoste betrokke by die aflaai en gebruik van die MyFitnessPal-program (gratis weergawe).

Is daar enigeiets anders wat jy moet weet of doen voor jy voortgaan met die vraelys?

Deur onderstaande toestemming te gee, dui jy aan dat jy kies om deel te neem aan *Fase 1* van hierdie studie. Na jy toestemming gegee het, kan jy begin met die vraelys.

In die laaste gedeelte van die vraelys kan jy aandui of jy belangstel om deel te neem aan *Fase 2*. As jy kies om deel te neem, sal jy versoek word om:

1) die gratis weergawe van die MyFitnessPal-program op jou selfoon af te laai en te gebruik. vir 'n tydperk van 1 maand, waarna

2) jy versoek sal word om 'n finale elektroniese vraelys te voltooi.

Deelname is heeltemal vrywillig en jy kan enige tyd kies om te onttrek. Vir hierdie tweede fase van die studie kan twee deelnemers elkeen 'n inkopiebewys van R2000 wen. Deelnemers wat belangstel om deel te neem aan *Fase 2*, sal meer inligting ontvang in Mei 2018.

Indien u enige navrae het of probleme ondervind, kontak asseblief:

Navorser / student: Me. C Slazus RD (SA): +351 911 884 660 of cslazus@gmail.com

Studieleier: Mev. Z Ebrahim RD (SA): (+27) 21 938 9259 of zarina@sun.ac.za

Studieleier: Mev. N Koen, RD (SA): (+27) 21 938 9259 of nelene@sun.ac.za

Jy kan die Gesondheidsnavorsingsetiekkomitee (HREC) by (021) 938 9207 skakel indien jy enige kommers of klagtes het wat nie behoorlik aangespreek is nie.

Hierdie studie en die navorsingspan is in geen manier geassosieer met MyFitnessPal en/of Under Armour, Inc nie. Geen bevordering, ondersteuning of goedkeuring van MyFitnessPal en Under Armour is geassosieer met die inhoud van hierdie studie nie.

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*In order to proceed, please provide consent by ticking the box below: / *Om voort te gaan, merk asseblief die onderstaande blokkie*:

☐ I have read, and I understand, the information presented to me and I agree to take part in the study / *Ek het die inligting wat aan my voorgelê is gelees, ek verstaan dit, en ek stem in om deel te neem aan die studie.*

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

In this section, you will be asked some general questions.

Instructions:

1. Please answer the following questions in the space provided for each (questions 1 – 7).

2. For multiple choice questions, please mark your choice by allocating the appropriate box.

3. If you are requested to specify, please keep it concise.

---

*Question 1:   Please enter your date of birth.

[_____] 🔲

*Question 2:   Please indicate your gender.

○ Female

○ Male

*Question 3:   Please indicate your race.

○ Asian

○ Black African

○ Coloured

○ Indian

○ White

○ Other (please specify):

*Question 4:   Please indicate your home language.

○ Afrikaans

○ English

○ IsiXhosa

○ isiZulu

○ isiNdebele

○ Sesotho

○ Setswana

○ SiSwati

○ Tshivenda

○ Xitsonga

○ Sepedi

○ Other (please specify):

*Question 5:   Which undergraduate degree program are you currently studying?

[_____]

*Question 6:   In which year of studies are you currently?

○ 1st year

○ 2nd year

○ 3rd year

○ 4th year

○ 5th year

○ 6th year

○ Other (please specify):

*Question 7:   What type of accommodation do you currently mainly reside in?

○ Campus residence

○ Private accommodation (alone)

○ Private accommodation (sharing)

○ Parental home

○ Other (please specify):

○ Private accommodation (alone)

○ Private accommodation (sharing)

○ Parental home

○ Other (please specify):

SECTION B: LIFESTYLE & DIETARY INFORMATION

In this section, you will be asked some questions regarding your lifestyle and general dietary behaviour.

Instructions:
1. Please answer the following questions (questions 1 – 12).
2. Please mark your choice by allocating the appropriate box.
3. If you are requested to specify, please keep it concise.

---

* Question 1: Please enter your current weight in kilograms (kg)?

[   ]

*Question 2: Please enter your height in meters (m)?

[   ]

*Question 3: How often do you think you consume a healthy, balanced diet?

○ Always

○ Mostly

○ Sometimes

○ Never

*Question 4: Where do you consume most of your meals?

*Please choose only one answer

○ Campus or residence cafeteria

○ Restaurants/coffee shops/delis

○ At home - take-aways

○ At home - ready-made meals (quick microwave or oven meals)

○ At home - homemade meals

○ Other (please specify):

*Question 5: Which of the following statements best describes how you feel about your weight?

○ I am completely happy with my weight

○ I would like to gain some weight

○ I would like to lose some weight e.g. 1-4kg

○ I would like to lose 5kg or more

*Question 6.1: Do you want to improve your diet in order to be healthier?

○ Yes

○ No

*Question 6.2: Do you want to improve your diet in order to improve your weight?

○ Yes

○ No

*Question 7: Do you actively search for information on how to improve your diet?

○ Yes

○ No

*Question 8: How many times did you eat a serving of the following foods over the last 7 days?

	No times	1-2 times	3-5 times	More than 6 times
Beef burgers or sausages	○	○	○	○
Beef, pork or lamb	○	○	○	○

Fried food (e.g. fried chicken/fish/calamari, fried onion rings, cheese sticks etc.)	○	○	○	○
Pies, quiches or pastries	○	○	○	○
Chips or fast food	○	○	○	○
Bacon or other processed meat (e.g. viennas, sandwich meats such as ham, salami, polony, canned meat etc.)	○	○	○	○
Crisps	○	○	○	○
Cheese	○	○	○	○

*Question 9: Over the last 7 days, how many times per day did you eat or drink the following:

	Less than once	1-2 times	3-5 times	More than 6 times
Chocolates or sweets	○	○	○	○
Biscuits	○	○	○	○
Sugary drinks (fizzy drinks, diluting juice or fruit juice)	○	○	○	○

*Question 10: Over the last 7 days, how much milk have you used (per day) for drinking or in cereal, tea or coffee?

○ Less than 125ml

○ About 125ml

○ About 250ml

○ More than 500ml

*Question 11: Which kind of milk do you usually use?

○ Full cream milk

○ Low fat milk

○ Fat free milk

*Question 12: Over the last 7 days, how many times (per day) have you eaten fruit and vegetables?

○ Less than once

○ 1-2 times

○ 3-5 times

○ More than 6 times

SECTION C: MOBILE HEALTH APPLICATION USAGE

In this section, you will be asked some questions about your use of mobile devices and health applications ('apps').

Instructions:

1. Please answer the following questions. Only one answer can be chosen for each question, unless otherwise specified. Mark your choice by allocating the appropriate box.

2. If you are requested to specify, please keep it short and concise.

---

*Question 1: Do you have a smartphone?

○ Yes

○ No

*Question 1.1: Which type of smartphone are you currently using?

○ Apple iPhone

○ Blackberry

○ Samsung

○ Huawei

○ LG

○ Nokia

○ HTC

○ Motorola

○ Other (please specify):

*Please indicate the model of the smartphone that you are using in the space provided:

[   ]

*Question 2: Which payment option do you currently have on your mobile phone?

○ Pay-as-you-go / Prepaid

○ Contract

○ Other (please specify):

*Question 3: Which sources do you currently use to find diet and health related information?

*You may choose more than one answer.

☐ A health worker (clinic/doctor/dietitian etc.)

☐ Print media e.g. magazines and newspapers

☐ Electronic media e.g. internet and social media

☐ Family and friends

☐ I am not currently interested in diet and health related information

☐ Other (please specify):

*Question 4: Are you aware of mobile health apps that allow you to track your diet?

*These apps usually contain a food diary

○ Yes

○ No

*Question 5: Do you think that monitoring (or tracking) what you eat will aid in improving ones dietary intake and overall wellness?

○ Yes

○ No

*Question 6: How important do you think tracking your diet is in improving your dietary intake and overall wellness?

○ Very important

Sligtly important

Not very important

Not important at all

*Question 7: Have you ever made use of any health app(s) that allow you to track your diet?

*Health apps with a food diary

Yes

No

*Question 7.1(a): Where did you hear about health apps that allow you to track your diet?

Please indicate all applicable options. More than one answer may be chosen.

A health worker (clinic/doctor/dietitian etc.)

Print media e.g. magazines and newspapers

Electronic media e.g. internet and social media

Family and friends

Other (please specify):

*Question 7.1(b): Which sources have you used to download health apps that allow you to track your diet?

*Please indicate all applicable options. More than one answer may be chosen.

Electronic media e.g. internet and social media

The app store on your mobile device

Other (please specify)

*Question 7.1(c): What are the names of the health app(s) that you have used to track your diet?

*Please indicate all applicable options. More than one answer may be chosen.

Rise Up

Calorific

My Diet Coach

MyFitnessPal

Lose It!

MyNetDiary

My Food Diary

MyPlate

HAPIcoach

Other (please specify):

*Question 7.1(d): How often did/do you use the health app to track your diet?

Every day

At least once per week

A few times per week

A few times per month

A few times, and never again

Other:

*Question 7.1(e): Have you paid for any app that allows you to track your diet?

Yes

No

*Question 7.1(f): How much are you willing to spend on an app to track your diet or give you dietary information?

I am not willing to pay for an app such as this

R1 - R50

R51 - R100

R101 - R250

R251 - R500

More than R500

*Question 7.1(a): Would you be interested in finding out more about health apps that allow you to track your diet and give you information on how to improve it?

○ Yes

○ No

*Question 7.1(b): Why have you never used a mobile health app in order to track your diet?

*You may choose more than one answer.

☐ I was not aware these apps existed

☐ I do not know where to find these apps

☐ I do not know how to use these apps

☐ I do not trust that these apps will accurately analyse my diet

☐ I do not trust the health information provided by these apps

☐ I do not want to spend my mobile data on these apps

☐ I do not have time to use these apps

☐ I am not interested in these apps

☐ Other (please specify):

SECTION D: FOLLOW-UP INFORMATION

In this section, you may provide your details to be entered into the lucky draw, and indicate whether you would like to participate in the second, and final, phase of this study.

Instructions:

1. Please answer the following questions in the space provided.
2. Please submit the survey once all the questions are answered.

Question 1: In order to be entered into the lucky draw, please provide your email address below.

*This information will only be used for the purpose of the lucky draw, and will be destroyed thereafter.

*Question 2: Would you be interested in taking part in Phase 2 of this study?

Phase 2 will look at the usability of a specific health app (MyFitnessPal) and whether using the app helps the user to make better food choices.

It will require you to download and use the free version of MyFitnessPal for a period of 1 month, on your own, after which you will be asked to complete and submit a final online survey about your experience using the app.

If you decide to take part in *Phase 2*, You will be entered into a lucky draw, where **2 participants stand the chance of winning a shopping voucher to the value of R2000 each!**

○ Yes, I would like to take part in Phase 2.

○ No, I would not like to take part in Phase 2.

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ADDENDUM B: PHASE 2 SURVEY: THE USABILITY AND PERCEIVED EFFICACY OF A HEALTH APP THAT TRACKS DIETARY INTAKE

Electronic Survey Assessing the Usability and Perceived Efficacy of a Health App that Tracks Dietary Intake

GENERAL INFORMATION AND CONSENT

Thank you for participating in *Phase 2* of the research study entitled: *Mobile health applications in wellness: an assessment of needs, perceptions, usability and efficacy in changing dietary choices.*

Please take some time to read the information presented below, which will explain the details of Phase 2 of the study. If you have any queries, please do not hesitate to contact the researcher (details provided below).

Your participation is entirely voluntary and you are free to decline to participate. You are also free to withdraw from the study at any point, even if you do agree to take part. All the information you provide will be kept private and confidential and will only be used for the purpose of the study.

This study has been approved by the Health Research Ethics Committee at Stellenbosch University (Ref. S17/10/247) and will be conducted according to the ethical guidelines and principles of the International Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is the study about?

This study follows a previous wellness study done on campus, that found students need and want help on improving their diet. This survey forms part of the final (*Phase 2*) of two phases of the study.

In the previous phase, *Phase 1*, we assessed

1) whether there is a need for mobile health applications (apps), with focus on the ones that track your diet, as a tool for monitoring and improving your diet, and

2) what the general perception is of these diet-tracking apps.

In the current phase, *Phase 2*, a specific mobile health app (MyFitnessPal) will be assessed, in particular its usability, and whether it helps the user to make healthier food choices.

Why have you been invited to participate?

In *Phase 1* of the study, you volunteered to participate in Phase 2. In addition, as a currently registered undergraduate student at Stellenbosch University, between the ages of 18 and 25 years old, you form part of the inclusion criteria of the study.

What will your responsibilities be?

For this phase of the study, you downloaded and installed the free version of MyFitnessPal on your phone or tablet and used it for a period of 3 weeks. Now, you will be asked to complete and submit a final online survey (in the same format as the survey you completed in *Phase 1*). It should take you no more than 10-15 minutes to complete. You will be requested to specify your weight (in kilograms).

Are there any risks involved in your taking part in this study?

No, there are no risks involved.

Will you be paid to take part in this study and are there any costs involved?

In *Phase 2* of the study, there are possible data costs involved in the download and use of the MyFitnessPal app (free version). You will be entered into a lucky draw, where two lucky participants stand the chance to win a shopping voucher worth R2000 each.

If you have any queries or encounter any problems, you can contact any member of the research team:

Researcher/student: Ms C Stazus RD(SA): +351 911 884 660 or cstazus@gmail.com
Study Leader: Mrs Z Ebrahim RD(SA): (+27) 21 938 9259 or zarina@sun.ac.za
Study Leader: Dr N Koen RD(SA): (+27) 21 938 9259 or nelene@sun.ac.za

You can contact the Health Research Ethics Committee at (021) 938 9207 if you have any concerns or complains that have not been adequately addressed.

This study and the researchers are in no way affiliated with MyFitnessPal and/or Under Armour, Inc. The material and contents of this study is not promoted, supported or approved by MyFitnessPal and/or Under Armour.

ALGEMENE INLIGTING EN TOESTEMMING

Dankie vir jou deelname aan *Fase 2* van die studie getiteld: *Mobile health applications in wellness: an assessment of needs, perceptions, usability and efficacy in changing dietary choices.*

Neem asseblief tyd om die inligting hieronder te lees. Dit sal die besonderhede van die studie verduidelik. Indien jy enige navrae het, moet asseblief nie huiwer om enige lid van die navorsingspan te kontak nie (besonderhede hieronder verskaf).

Jou deelname is heeltemal vrywillig. Jy kan ook op enige stadium van die studie onttrek, selfs al stem jy in om deel te neem. Al die inligting wat jy verskaf, sal privaat en vertroulik gehou word en sal slegs vir die doel van die studie gebruik word.

Hierdie studie is goedgekeur deur die Gesondheidsnavorsingsetiekkomitee aan die Universiteit Stellenbosch (HREC Verw. S17/10/247) en sal uitgevoer word volgens die etiese riglyne en beginsels van die Internasionale Verklaring van Helsinki, Suid-Afrikaanse Riglyne vir Goeie Kliniese Praktyk en die Mediese Navorsingsraad (MRC) Etiese Riglyne vir Navorsing.

Waaroor gaan die studie?

Hierdie studie volg op 'n vorige welweesstudie wat op die kampus gedoen is, wat gevind het dat studente hulp nodig het, en graag wil hê, om hul dieet te verbeter. Hierdie opname vorm deel van die finale fase (*Fase 2*) van twee fases van die studie.

In die vorige fase het on die volgende assesseer:

1) of daar 'n behoefte is aan mobiele gesondheidsprogramme ('apps'), met die fokus op diès wat jou dieet opneem, as 'n instrument vir die monitering en verbetering van dieet, en

2) wat die algemene persepsie is van hierdie 'apps'.

In die huidige fase, Fase 2, word 'n spesifieke mobiele gesondheids 'app' (MyFitnessPal) geassesseer, veral die bruikbaarheid daarvan, en of dit die gebruiker help om gesonder voedselkeuses te maak.

Hoekom is jy genooi om deel te neem?

In Fase 1 van die studie, het jy aangedui dat jy aan Fase 2 wil deeldeem. Ook, as 'n geregistreerde voorgraadse student aan die Universiteit van Stellenbosch, tussen die ouderdomme van 18 en 25 jaar, vorm jy deel van die insluitingskriteria van hierdie studie.

Wat sal jou verantwoordelikhede wees?

Vir hierdie fase (Fase 2) van die studie is jy gevra om die gratis weergawe van die mobiele gesondheidsprogram ('app') MyFitnessPal af te laai op jou mobiele foon of tablet, en dit te gebruik vir 3 weke. Nou word jy versoek om 'n finale elektroniese opname te voltooi (dit volg dieselfde formaat as die vorige, Fase 1 opname). Dit sal jou nie langer as 10 – 15 minute neem om te voltooi nie. Jy sal versoek word om jou gewig (in kilogram) te spesifiseer.

Is daar enige risiko's betrokke in jou deelname aan hierdie studie?

Nee, daar is geen risiko's betrokke nie.

Sal jy betaal word om aan hierdie studie deel te neem en is daar enige koste daaraan verbonde?

In Fase 2 van die studie is daar moontlike datakoste betrokke by die aflaai en gebruik van die MyFitnessPal-program (gratis weergawe). Twee deelnemers staan die kans om 'n inkopiebewys van R2000 elk te wen.

Indien jy enige navrae het of probleme ondervind, kontak asseblief:

Navorser / student: Me. C Slazus RD (SA): +351 911 884 660 of cslazus@gmail.com

Studieleier: Mev. Z Ebrahim RD (SA): (+27) 21 938 9259 of zarina@sun.ac.za

Studieleier: Dr N Koen, RD (SA): (+27) 21 938 9259 of nelene@sun.ac.za

Jy kan die Gesondheidsnavorsingsetiekkomitee (HREC) by (021) 938 9207 skakel indien jy enige kommers of klagtes het wat nie behoorlik aangespreek is nie.

Hierdie studie en die navorsingspan is in geen manier geassosieer met MyFitnessPal en/of Under Armour, Inc nie. Geen bevordering, ondersteuning of goedkeuring van MyFitnessPal en Under Armour is geassosieer met die inhoud van hierdie studie nie.

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*In order to proceed, please provide consent by ticking the box below: / _Om voort te gaan, merk asseblief die onderstaande blokkie:_

☐ I have read, and I understand, the information presented to me and I agree to take part in the study / _Ek het die inligting wat aan my voorgelê is gelees, ek verstaan dit, en ek stem in om deel te neem aan die studie._

SECTION A: THE USABILITY OF MYFITNESSPAL

In this section, you will be asked about your experience using the MyFitnessPal app - from setting up your profile, to tracking your diet, to the health information provided by the app. Please answer all the questions.

Instructions:

1. Please indicate whether you agree or disagree with the statements (questions 1 – 9).
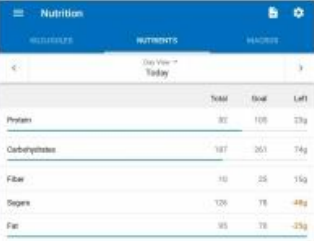2. Mark your choice by allocating the appropriate box.

*

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. The MyFitnessPal mobile application is simple and easy to use.	○	○	○	○
2. I experienced difficulties in setting up my MyFitnessPal user profile in the app.	○	○	○	○
3. I experienced difficulties in setting personal goals in the app.	○	○	○	○
4. I experienced difficulties in knowing which food or drink item to select from the list.	○	○	○	○
5. I experienced difficulties in adding food or drink items to my MyFitnessPal Food Diary.	○	○	○	○
6. I experienced difficulties in adding the correct portion sizes to my Food Diary.	○	○	○	○
7. I exerienced difficulties in adding food or drink items using the barcode scanner.	○	○	○	○
8. I experienced difficulties in adding new food or drink items (creating my own recipes, meals and foods).	○	○	○	○
9. The nutritional information was presented in the app (in tables, charts and graphs) in a meaningful way that I could understand.	○	○	○	○

SECTION B: THE EFFICACY OF MYFITNESSPAL

In this section, you will be asked more questions about your experience using the MyFitnessPal mobile application – the focus will be on how you used the app, what your opinion is about the app and the information provided by the app, and whether you think the app was useful to you.

Instructions:

1. Please indicate whether you agree or disagree with the following statements (questions 1 – 13).
2. Mark your choice by allocating the appropriate box.

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Becoming aware of my food choices by tracking my diet (using the app) will help to improve my health.	○	○	○	○
2. It was easy to improve my food choices and dietary routine, based on the information I gained from using the app.	○	○	○	○
3. I understood the information on the breakdown of the energy (or kilojoule) content of my meals (screenshot in picture below).	○	○	○	○
4. Seeing the breakdown of the energy (or kilojoule) content of my meals, in a pie chart, was helpful in improving my food choices and dietary routine.	○	○	○	○
5. I changed my food intake in order to meet my goal energy (or kilojoule) intake.	○	○	○	○
6. I understood the information on the breakdown of my nutrient intake (example screenshot below).	○	○	○	○
7. Seeing the breakdown of my nutrient intake, in table format, was helpful in improving my food choices and dietary routine.	○	○	○	○
8. I changed my food intake in order to meet certain nutrient goals.	○	○	○	○
9. I understood the information on the breakdown of my macronutrient distribution or *macros* (example screenshot				

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below).

10. Seeing the breakdown of my macronutrient distribution or *macros*, in a pie chart, was helpful in improving my food choices and dietary routine.	○	○	○	○
11. I changed my food intake in order to meet my macronutrient distribution or *macros* goals.	○	○	○	○
12. I have learnt something new about achieving a healthy diet and lifestyle by using MyFitnessPal.	○	○	○	○
13. Using MyFitnessPal helped me to make dietary changes.	○	○	○	○

Instructions:

1. Mark your choice by allocating the appropriate box.
2. Please enter you weight in kilograms (question 15 & 17)

*14. Did you set a weight goal while using MyFitnessPal?

○ Yes

○ No

*15. What was the weight (in kilograms) you used to set up your profile goals?

[_____]

*16. Which of the following did you indicate regarding your goal weight?

○ That I want to lose weight

○ That I want to stay the same weight

○ That I want to gain weight

*What is your current weight (in kilograms)?

[_____]

*18. Did you change the energy (or kilojoule) goal that was recommended by MyFitnessPal after setting up your profile?

○ Yes

○ No

*19. What did you think of the energy (or kilojoule) goal that was recommended by MyFitnessPal when setting up your profile?

○ It was too low

○ It was just right

○ It was too high

○ I don't know

*20. Did you set fitness goals while using MyFitnessPal?

○ Yes

○ No

*21. Did you make use of the *Community* feature of MyFitnessPal?

○ Yes

○ No

*21a. Do you feel that the *Community* feature helped you to stay motivated to continue to improve your diet?

○ Yes

○ No

○ I am not sure

*22. Do you feel that using MyFitnessPal helped you to achieve the goals you set?

○ Yes

○ No

○ I am not sure

Instructions:

1. Please mark your choice by allocating the appropriate box (questions 20 – 24).

*20. How many times did you eat a serving of the following foods over the last 7 days?

	No times	1-2 times	3-5 times	More than 6 times
Beef burgers or sausages	○	○	○	○
Red meat e.g. beef, pork, mutton or lamb	○	○	○	○
Fried food (e.g. fried chicken/fish/calamari, fried onion rings, cheese sticks etc.)	○	○	○	○
Pies, quiches or pastries	○	○	○	○
Chips or fast food	○	○	○	○
Bacon or other processed meat (e.g. viennas, sandwich meats such as ham, salami, polony, canned meat etc.)	○	○	○	○
Crisps	○	○	○	○
Cheese	○	○	○	○

*21. Over the last 7 days, how many times per day did you eat or drink the following?

	Less than once	1-2 times	3-5 times	More than 6 times
Chocolates or sweets	○	○	○	○
Biscuits	○	○	○	○
Sugary drinks (fizzy drinks, diluting juice or fruite juice)	○	○	○	○

*22. Over the last 7 days, how much milk have you used (per day) for drinking or in cereal, tea or coffee?

○ Less than 125ml

○ About 125ml

○ About 250ml

○ More than 500ml

*23. Which kind of milk do you usually use?

○ Full cream milk

○ Low fat milk

○ Fat free milk

*24. Over the last 7 days, how many times (per day) have you eaten fruit and vegetables?

○ Less than once

○ 1-2 times

○ 3-5 times

○ More than 6 times

Instructions:

1. Please answer the following questions (questions 25 – 29).

2. When asked to specify, please keep it concise.

*25. Do you feel that MyFitnessPal is missing anything that would have helped you to improve your food choices and dietary routine?

Please elaborate.

*26. I prefer using an app like MyFitnessPal to record my diet, compared to pen and paper.

Strongly agree			Strongly disagree
○	○	○	○
1	2	3	4

*27. On average during the last month, how many days per week did you use MyFitnessPal?

○ Once per week

○ Twice per week

○ 3 times per week

○ 4 times per week

○ 5 times per week

○ Every day of the week

○ More than once per day

*28. During the last month, did you use MyFitnessPal less as the weeks passed?

○ Yes

○ No

*29. Do you think you will keep using MyFitnessPal after this study has ended?

○ Yes

○ No

*29a. Why do you not want to keep using MyFitnessPal?

You may choose more than one answer.

☐ It is not fun to use

☐ It is tedious to use

☐ I don't have time to use it

☐ It is too expensive/uses too much data

☐ I did not find it useful

☐ I do not want help to improve my diet

☐ Other (please specify):

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SECTION C: FOLLOW-UP INFORMATION

In this section, you may provide your details to be entered into the lucky draw.

Instructions:

1. Please answer the following question in the space provided.
2. Please submit the survey once all the questions are answered.

In order to be entered into the lucky draw, please provide the SAME EMAIL ADDRESS you provided in the first survey, below.

*This information will only be used for the purpose of the lucky draw and to link your dietary data for the purpose of the study, and will be destroyed thereafter.

ADDENDUM C: STELLENBOSCH UNIVERSITY HEALTH RESEARCH ETHICS COMMITTEE APPROVAL

UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

Health Research Ethics Committee (HREC)

Approval Notice

New Application

07/12/2017

Project ID:1477

HREC Reference #: S17/10/247

Title: Mobile health applications in wellness: an assessment of needs, perceptions, usability and efficacy in changing dietary choices

Dear Ms C Slazus,

The **New Application** received on 25/10/2017 was reviewed by members of **Health Research Ethics Committee** via **expedited** review procedures on 07/12/2017 and was approved.

Please note the following information about your approved research protocol:

Protocol Approval Period: **07-Dec-2017 – 06-Dec-2018**

Please remember to use your Project ID [1477] on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review

Please note you can submit your progress report through the online ethics application process, available at: https://applyethics.sun.ac.za/Project/Index/1610 and the application should be submitted to the Committee before the year has expired. Please see Forms and Instructions on our HREC website for guidance on how to submit a progress report.

The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Translation of the consent document(s) to the language(s) applicable to your study participants should now be submitted to the HREC.

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility, permission must still be obtained from the relevant authorities (Western Cape Departement of Health and/or City Health) to conduct the research as stated in the protocol. Please consult the Western Cape Government website for access to the online Health Research Approval Process, see: https://www.westerncape.gov.za/general-publication/health-research-approval-process. Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.

For standard HREC forms and instructions, please visit: Forms and Instructions on our HREC website Links Application Form Direct Link

If you have any questions or need further assistance, please contact the HREC office at 021 938 9677.

Yours sincerely,

Francis Masiye,

Page 1 of 2

HREC Coordinator,

Health Research Ethics Committee 2 (HREC 2).

Federal Wide Assurance Number: 00001372

Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No. 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki and the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles, Structures and Processes 2015 (Departement of Health).

ADDENDUM D: STELLENBOSCH UNIVERSITY INSTITUTIONAL PERMISSION

UNIVERSITEIT • STELLENBOSCH • UNIVERSITY
jou kennisvennoot • your knowledge partner

INSTITUTIONAL PERMISSION:

AGREEMENT ON USE OF PERSONAL INFORMATION IN RESEARCH

Name of Researcher:	Cecile Slazus
Name of Research Project:	Mobile health applications in wellness: an assessment of needs, perceptions, usability and efficacy in changing dietary choices.
Service Desk ID:	IRPSD 784
Date of Issue:	15 February 2018

You have received institutional permission to proceed with this project as stipulated in the institutional permission application and within the conditions set out in this agreement.

1	**WHAT THIS AGREEMENT IS ABOUT**	
What is POPI?	1.1	POPI is the Protection of Personal Information Act 4 of 2013.
	1.2	POPI regulates the entire information life cycle from collection, through use and storage and even the destruction of personal information.
Why is this important to us?	1.3	Even though POPI is important, it is not the primary motivation for this agreement. The privacy of our students and employees are important to us. We want to ensure that no research project poses any risks to their privacy.
	1.4	However, you are required to familiarise yourself with, and comply with POPI in its entirety.
What is considered to be personal information?	1.5	'Personal information' means information relating to an identifiable, living, individual or company, including, but not limited to:
	1.5.1	information relating to the race, gender, sex, pregnancy, marital status, national, ethnic or social origin, colour, sexual orientation, age, physical or mental health, well-being, disability, religion, conscience, belief, culture, language and birth of the person;
	1.5.2	information relating to the education or the medical, financial, criminal or employment history of the person;

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Institutional Permission Standard Agreement: 13 March 2017 V1

	1.5.3	any identifying number, symbol, e-mail address, physical address, telephone number, location information, online identifier or other particular assignment to the person;
	1.5.4	the biometric information of the person;
	1.5.5	the personal opinions, views or preferences of the person;
	1.5.6	correspondence sent by the person that is implicitly or explicitly of a private or confidential nature or further correspondence that would reveal the contents of the original correspondence;
	1.5.7	the views or opinions of another individual about the person; and
	1.5.8	the name of the person if it appears with other personal information relating to the person or if the disclosure of the name itself would reveal information about the person.
Some personal information is more sensitive.	1.6	Some personal information is considered to be sensitive either because:
	1.6.1	POPI has classified it as sensitive;
	1.6.2	if the information is disclosed it can be used to defraud someone; or
	1.6.3	the disclosure of the information will be embarrassing for the research subject.
	1.7	The following personal information is considered particularly sensitive:
	1.7.1	Religious or philosophical beliefs;
	1.7.2	race or ethnic origin;
	1.7.3	trade union membership;
	1.7.4	political persuasion;
	1.7.5	health and health related documentation such as medical scheme documentation;
	1.7.6	sex life;
	1.7.7	biometric information;
	1.7.8	criminal behaviour;
	1.7.9	personal information of children under the age of 18;
	1.7.10	financial information such as banking details, details relating to financial

		products such as insurance, pension funds or other investments.
	1.8	You maymake use of this type of information, but must take extra care to ensure that you comply with the rest of the rules in this document.

2   COMMITMENT TO ETHICAL AND LEGAL RESEARCH PRACTICES

You must commit to the use of ethical and legal research practices.	2.1	You must obtain ethical clearance before commencing with this study.
	2.2	You commit to only employing ethical and legal research practices.
You must protect the privacy of your research subjects.	2.3	You undertake to protect the privacy of the research subjects throughout the project.

3   RESEARCH SUBJECT PARTICIPATION

Personal information of identifiable research subjects must not be used without their consent.	3.1	Unless you have obtained a specific exemption for your research project, consent must be obtained in writing from the research subject, before their personal information is gathered.
Research subjects must be able to withdraw from the research project.	3.2	Research subjects must always be able to withdraw from the research project (without any negative consequences) and to insist that you destroy their personal information.
Consent must be specific and informed.	3.3	Unless you have obtained a specific exemption for your research project, the consent must be specific and informed. Before giving consent, the research subject must be informed in writing of:
	3.3.1	The purpose of the research,
	3.3.2	what personal information about them will be collected (particularly sensitive personal information),
	3.3.3	how the personal information will be collected (if not directly from them),
	3.3.4	the specific purposes for which the personal information will be used,
	3.3.5	what participation will entail (i.e. what the research subject will have to do),
	3.3.6	whether the supply of the personal information is voluntary or mandatory for purposes of the research project,

	3.3.7	who the personal information will be shared with,
	3.3.8	how the personal information will be published,
	3.3.9	the risks to participation (if any),
	3.3.10	their rights to access, correct or object to the use of their personal information,
	3.3.11	their right to withdraw from the research project, and
	3.3.12	how these rights can be exercised.
Consent must be voluntary.	3.4	Participation in the research project must always be voluntary. You must never pressure or coerce research subjects into participating and persons who choose not to participate must not be penalised.
Using the personal information of children?	3.5	A child is anybody under the age of 18.
	3.6	Unless you have obtained a specific exemption in writing for your research project, you must obtain
	3.6.1	the consent of the child's parent or guardian, and
	3.6.2	if the child is over the age of 7, the assent of the child,
		before collecting the child's information.
Research subjects have a right to access.	3.7	Research subjects have the right to access their personal information, obtain confirmation of what information is in your possession and who had access to the information. It is strongly recommended that you keep detailed records of access to the information.
Research subjects have a right to object.	3.8	Research subjects have the right to object to the use of their personal information.
	3.9	Once they have objected, you are not permitted to use the personal information until the dispute has been resolved.

4   COLLECTING PERSONAL INFORMATION

Only collect what is necessary.	4.1	You must not collect unnecessary or irrelevant personal information from research subjects.
Only collect accurate personal information.	4.2	You have an obligation to ensure that the personal information you collect is accurate. Particularly when you are collecting it from a source other than the

		research subject.
	4.3	If you have any reason to doubt the quality of the personal information you must verify or validate the personal information before you use it.

5 USING PERSONAL INFORMATION

Only use the personal information for the purpose for which you collected it.	5.1	Only use the personal information for the purpose for which you collected it.
	5.2	If your research project requires you to use the personal information for a materially different purpose than the one communicated to the research subject, you must inform the research subjects and Stellenbosch University of this and give participants the option to withdraw from the research project.
Be careful when you share personal information.	5.3	Never share personal information with third parties without making sure that they will also follow these rules.
	5.4	Always conclude a non-disclosure agreement with the third parties.
	5.5	Ensure that you transfer the personal information securely.
Personal information must be anonymous whenever possible.	5.6	If the research subject's identity is not relevant for the aims of the research project, the personal information must not be identifiable. In other words, the personal information must be anonymous (de-identified).
Pseudonyms must be used whenever possible.	5.7	If the research subject's identity is relevant for the aims of the research project or is required to co-ordinate, for example, interviews, names and other identifiers such as ID or student numbers must be collected and stored separately from the rest of the research data and research publications. In other words, only you must be able to identify the research subject.
Publication of research	5.8	The identity of your research subjects should not be revealed in any publication.
	5.9	In the event that your research project requires that the identity of your research subjects must be revealed, you must apply for an exemption from this rule.

6 SECURING PERSONAL INFORMATION

You are responsible for the confidentiality and security of the personal information	6.1	Information must always be handled in the strictest confidence.
	6.2	You must ensure the integrity and security of the information in your possession or under your control by taking appropriate and reasonable technical and

		organisational measures to prevent:
	6.2.1	Loss of, damage to or unauthorised destruction of information; and
	6.2.2	unlawful access to or processing of information.
	6.3	This means that you must take reasonable measures to:
	6.3.1	Identify all reasonably foreseeable internal and external risks to personal information in your possession or under your control;
	6.3.2	establish and maintain appropriate safeguards against the risks identified;
	6.3.3	regularly verify that the safeguards are effectively implemented; and
	6.3.4	ensure that the safeguards are continually updated in response to new risks or deficiencies in previously implemented safeguards.
Sensitive personal information requires extra care.	6.4	You will be expected to implement additional controls in order to secure sensitive personal information.
Are you sending any personal information overseas?	6.5	If you are sending personal information overseas, you have to make sure that:
	6.5.1	The information will be protected by the laws of that country;
	6.5.2	the company or institution to who you are sending have agreed to keep the information confidential, secure and to not use it for any other purpose; or
	6.5.3	get the specific and informed consent of the research subject to send the information to a country which does not have data protection laws.
Be careful when you use cloud storage.	6.6	Be careful when storing personal information in a cloud. Many clouds are hosted on servers outside of South Africa in countries that do not protect personal information to the same extent as South Africa. The primary example of this is the United States.
	6.7	It is strongly recommended that you use hosting companies who house their servers in South Africa.
	6.8	If this is not possible, you must ensure that the hosting company agrees to protect the personal information to the same extent as South Africa.

7 RETENTION AND DESTRUCTION OF PERSONAL INFORMATION

You are not entitled to retain personal information when	7.1	Personal information must not be retained beyond the purpose of the research project, unless you have a legal or other justification for retaining the information.

you no longer need it for the purposes of the research project.	
If personal information is retained, you must make sure it remains confidential.	7.2 If you do need to retain the personal information, you must assess whether: 7.2.1 The records can be de-identified; and/or whether 7.2.2 you have to keep all the personal information. 7.3 You must ensure that the personal information which you retain remains confidential, secure and is only used for the purposes for which it was collected.

8 INFORMATION BREACH PROCEDURE

In the event of an information breach you must notify us immediately.	8.1 If there are reasonable grounds to believe that the personal information in your possession or under your control has been accessed by any unauthorised person or has been disclosed, you must notify us immediately. 8.2 We will notify the research subjects in order to enable them to take measures to contain the impact of the breach.
This is the procedure you must follow.	8.3 You must follow the following procedure: 8.3.1 Contact the Division for Institutional Research and Planning at 021 808 9385 and permission@sun.ac.za; 8.3.2 you will then be required to complete the information breach report form which is attached as Annexure A. 8.4 You are required to inform us of a information breach within 24 hours. Ensure that you have access to the required information.

9 MONITORING

You may be audited.	9.1 We reserve the right to audit your research practices to assess whether you are complying with this agreement. 9.2 You are required to give your full co-operation during the auditing process. 9.3 We may also request to review: 9.3.1 Forms (or other information gathering methods) and notifications to research subjects, as referred to in clause 3;

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| | 9.3.2 | non-disclosure agreements with third parties with whom the personal information is being shared, as referred to in clause 5.4; |
| | 9.3.3 | agreements with foreign companies or institutes with whom the personal information is being shared, as referred to in clause 6.5. |

10   CHANGES TO RESEARCH

You need to notify us if any aspect of your collection or use of personal information changes.	10.1 You must notify us in writing if any aspect of your collection or use of personal information changes (e.g. such as your research methodology, recruitment strategy or the purpose for which you use the research).
	10.2 We may review and require amendments to the proposed changes to ensure compliance with this agreement.
	10.3 The notification must be sent to permission@sun.ac.za.

11   CONSEQUENCES OF BREACH

What are the consequences of breaching this agreement?	11.1 If you do not comply with this agreement, we may take disciplinary action or report such a breach to your home institute.
	11.2 You may be found guilty of research misconduct and may be censured in accordance with Stellenbosch University or your home institute's disciplinary code.
You may have to compensate us in the event of any legal action.	11.3 Non-compliance with this agreement could also lead to claims against Stellenbosch University in terms of POPI and/or other laws.
	11.4 Unless you are employed by or studying at Stellenbosch University, you indemnify Stellenbosch University against any claims (including all legal fees) from research subjects or any regulatory authority which are the result of your research project. You may also be held liable for the harm to our reputation should there be an information breach as a result of your non-compliance with this agreement.

12   CONTACT US

| Please contact us if you have any questions. | Should you have any questions relating to this agreement you should contact permission@sun.ac.za. |

Annexure 'A'

Instruction:

Please send this Notice to permission@sun.ac.za. If you have any difficulty completing the Notice, please contact the Division for Institutional Research and Planning at 021 808 9385. You must confirm that the Notice was received.

NOTIFICATION OF INFORMATION BREACH

Name of Researcher: _____

Name of Research Project: _____

Service Desk ID: _____

A security breach happens when you know (or you **reasonably believe**) that there has been:

    (a) loss of Personal Information ("PI")
    (b) damage to PI
    (c) unauthorised destruction of PI
    (d) unauthorised access to PI
    (e) unauthorised processing of PI

Date and time of security breach:	
Brief description of the security breach (what was lost and how). Please identify the equipment, software and/or physical premises and whether it is by hacking, lost device, public disclosure (email), theft or other means:	
Name of the person/s responsible for the security breach (if known):	
Is the security breach ongoing?	
Describe the steps taken to contain the security breach:	
What steps are being taken to investigate the cause of breach?	

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