

**THE IMPACT OF MYFITNESSPAL ON DAILY
CALORIE INTAKE AND FOOD CHOICES AMONG
UNDERGRADUATE HEALTH SCIENCES
STUDENTS IN USM HEALTH CAMPUS (USMKK)**

GEOGINA YAP JING XUAN

UNIVERSITI SAINS MALAYSIA

2026

**THE IMPACT OF MYFITNESSPAL ON DAILY
CALORIE INTAKE AND FOOD CHOICES AMONG
UNDERGRADUATE HEALTH SCIENCES
STUDENTS IN USM HEALTH CAMPUS (USMKK)**

by

GEOGINA YAP JING XUAN

**Thesis submitted in partial fulfilment
of the requirements for the degree of
Bachelor in Health Science (Honours)
(Nutrition)**

January 2026

CERTIFICATE

This is to certify that the dissertation entitled “THE IMPACT OF MYFITNESSPAL ON DAILY CALORIE INTAKE AND FOOD CHOICES AMONG UNDERGRADUATE HEALTH SCIENCES STUDENTS IN USM HEALTH CAMPUS (USMKK)” is the bona fide record of research work done by Ms. GEOGINA YAP JING XUAN during the period from October 2025 to January 2026 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfilment for the degree of Bachelor in Health Science (Honours) (Nutrition).

Main supervisor,

.....

Dr. Soo Kah Leng
Lecturer
School of Health Sciences
Universiti Sains Malaysia
Health Campus
16150 Kubang Kerian
Kelantan, Malaysia

Date:

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

.....

GEOGINA YAP JING XUAN

Date:

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude to my research supervisor, Dr Soo Kah Leng, for her invaluable guidance and constant encouragement throughout the process of my research. Without her consistent and illuminating instruction, I would not complete my thesis successfully. I would also be grateful to my kind lecturers and coursemates in the School of Health Sciences for their help in my life and studies during my four years at the university. I am particularly grateful to Universiti Sains Malaysia for providing me with valuable research materials.

In addition, I would like to express my special thanks to my family members, who have always been supportive and stood firmly behind every decision I made, despite not having been able to offer much guidance for my studies. I also would like to convey my heartfelt gratitude towards my friends for their motivation, patience, love and care during my education and life journey. Furthermore, I extend my heartfelt thanks to my participants who voluntarily involved themselves in this study. Thanks to all the people who have directly or indirectly helped me in completing my research and thesis.

Finally, I would like to extend gratitude to myself. From the moment the research topic was chosen to the final submission of the thesis, I held a firm belief in my own ability. Though I know the path would be challenging, I committed to doing the work that is truly meaningful to me. Life lies not in living but in liking. The road to the future is long and challenging, but I would like to be the one always on the road.

TABLE OF CONTENTS

CERTIFICATE.....	ii
DECLARATION	iii
ACKNOWLEDGEMENT.....	iv
TABLE OF CONTENTS	v
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF PLATES	xi
LIST OF SYMBOLS	xii
LIST OF ABBREVIATIONS	xiii
ABSTRAK.....	xiv
ABSTRACT.....	xvi
CHAPTER 1 INTRODUCTION.....	1
1.1 Background of Study	1
1.2 Problem Statement	2
1.3 Significance of Study	3
1.4 Research Questions	4
1.5 Research Objectives	4
1.5.1 General Objectives	4
1.5.2 Specific Objectives	4
1.6 Research Hypothesis	5
1.6.1 Null Hypothesis (H_0).....	5
1.6.2 Alternative Hypothesis (H_a).....	5
1.7 Theoretical Framework	5
CHAPTER 2 LITERATURE REVIEW	8
2.1 Introduction to the Research Problem.....	8

2.2	Current Food Choices among University Students.....	9
2.2.1	Dietary Habits, Trends and Their Impacts among University Students.....	9
2.2.2	Determinant of Food Choices	11
2.2.2(a)	Biologically determined predisposition and personal experience with food	12
2.2.2(b)	Person-related determinants	13
2.2.2(c)	Social and environmental influences.....	14
2.2.3	Level of Nutrition Knowledge	15
2.2.4	Challenges in Maintaining a Healthy Diet in University Setting ..	16
2.3	Role of Mobile Health (mHealth) apps.....	17
2.3.1	Growth, Impacts and Limitations of mHealth Apps	17
2.3.2	Nutrition-Related Mobile Apps and MyFitnessPal.....	19
2.3.3	Interventional Studies and Effectiveness of MyFitnessPal.....	21
2.4	Health Belief Model.....	22
2.4.1	Overview of the Health Belief Model (HBM).....	22
2.4.2	Application of the Health Belief Model in Dietary Behaviour Change	26
CHAPTER 3 METHODOLOGY		28
3.1	Study Design.....	28
3.2	Study Area.....	28
3.3	Study Population	28
3.4	Subject Criteria	29
3.4.1	Inclusion Criteria	29
3.4.2	Exclusion Criteria	29
3.4.3	Withdrawal Criteria	29
3.5	Sample Size Estimation	30
3.6	Sampling Method.....	33

3.7	Research Instrument.....	33
3.7.1	Sociodemographic Information and Body Mass Index (BMI)	33
3.7.2	Nutrition Knowledge Questionnaire	34
3.7.3	Survey Questions on Usability and Perceived Efficacy of MyFitnessPal.....	34
3.7.4	MyFitnessPal Application.....	35
3.7.5	Adapted Dietary Instrument for Nutrition Education (DINE)	35
3.8	Operational Definition	36
3.8.1	Usability and Perceived Efficacy of MyFitnessPal	36
3.8.2	Changes in Food Choices.....	37
3.8.3	Average Daily Calorie Intake	37
3.8.4	Nutrition Knowledge	37
3.9	Study Period.....	38
3.9.1	Intervention Period.....	38
3.10	Data Collection Method	39
3.11	Study Flowchart	41
3.12	Data Analysis	42
3.12.1	Level of Nutrition Knowledge	42
3.12.2	Usability and Perceived Efficacy of MyFitnessPal	42
3.12.3	Difference in average daily calorie intake	43
3.12.4	Analysis of DINE food frequency	43
3.13	Ethical Considerations	43
3.13.1	Subject Vulnerability	43
3.13.2	Declaration of Absence of Conflict of Interest	44
3.13.3	Privacy and Confidentiality	44
3.13.4	Communities Sensitivities and Benefits	45
3.13.5	Honorarium and Incentives.....	45

CHAPTER 4	RESULTS	46
4.1	Sociodemographic Characteristics of Undergraduate Health Sciences Students	46
4.2	Level of Nutrition Knowledge among Undergraduate Health Sciences Students	47
4.3	Usability and Perceived Efficacy of MyFitnessPal among participants	50
4.4	Average Daily Calorie Intake During the Intervention Period	53
4.4.1	Average Daily Calorie Intake Before and During Mid-Semester Break	55
4.5	DINE comparison before and after using MyFitnessPal	56
CHAPTER 5	DISCUSSION	58
5.1	Level of Nutrition Knowledge among Participants	58
5.2	Usability and Perceived Efficacy of MyFitnessPal among participants	59
5.3	Average Daily Calorie Intake During the Intervention Period	61
5.4	Changes in Food Choices based on DINE Food Groups	63
5.4.1	Significant Increase in Fatty Food Score	64
5.4.2	Non-Significant Increase in Sugary Food Score	65
5.4.3	Non-Significant Increase in Fruit and Vegetables Score	66
5.5	Limitations and Strengths of the Study	67
CHAPTER 6	CONCLUSION	69
6.1	Summary of Findings	69
6.2	Recommendations	69
REFERENCES.....		71
APPENDICES		

LIST OF TABLES

	Page
Table 4.1 Sociodemographic Characteristics and BMI Classification among Participants (N = 78).....	47
Table 4.2 Level of Nutrition Knowledge among participants (N = 78)	48
Table 4.3 Usability and Perceived Efficacy of MyFitnessPal among participants (N = 78).....	52
Table 4.4 Average Daily Calorie Intake during Week 1 and Week 3 of Intervention by Total and Weight Goal Groups (N = 78)	55
Table 4.5 Average Daily Calorie Intake Before & During Mid-Semester Break (N = 78)	56
Table 4.6 DINE Comparison before and after using MyFitnessPal (N = 78)	57

LIST OF FIGURES

	Page
Figure 1.1 Application of the Health Belief Model (HBM) in a Mobile Health Intervention to Improve Dietary Choices	7
Figure 2.1 Determinants of Food Choices (Contento, 2011).....	11
Figure 3.1 Study Flowchart	41
Figure 4.1 Percentage distribution of responses to Question 6: “The nutrients that provide us with the most energy (calories):” (N = 78)	49
Figure 4.2 Percentage distribution of responses to Question 12: “Which one of the foods listed below contains the highest amount of cholesterol?” (N = 78)	49
Figure 4.3 Percentage distribution of responses to Question 9: “In the list below, the food with the highest protein content:” (N = 78).....	50
Figure 4.4 Percentage distribution of responses to Question 18: “Obesity will increase risk of the following disease:” (N = 78)	50
Figure 4.5 Average Daily Calorie Intake during Week 1, Week 2 and Week 3 of Intervention by Total and Weight Goal Groups	55

LIST OF PLATES

	Page
Plate 3.1 G*Power analysis for 2 dependent means	31
Plate 3.2 G*Power analysis for 2 dependent means	32

LIST OF SYMBOLS

%	Percentage
<	Less than
=	Equals
±	Plus-minus
α	Significance level
$1-\beta$	Statistical power
Δ	Precision/margin of error
cm	Centimetre
kg	Kilogram
kg/m ²	Kilograms per metre squared
m	Metre
n	Sample size
p	Anticipated population proportion
Z	Z-score representing the desired confidence level

LIST OF ABBREVIATIONS

Apps	Applications
BCT	Behavioural Change Theory
BMI	Body Mass Index
CI	Confidence Interval
DINE	Dietary Instrument for Nutrition Education
HBM	Health Belief Model
MFP	MyFitnessPal
mHealth	Mobile Health
NCD	Non-Communicable Disease
N/A	Not Applicable
NPANM III	National Plan of Action for Nutrition of Malaysia III
PPSG	Pusat Pengajian Sains Pergigian (School of Dental Sciences)
PPSK	Pusat Pengajian Sains Kesihatan (School of Health Sciences)
PPSP	Pusat Pengajian Sains Perubatan (School of Medical Sciences)
RCT	Randomised Control Trial
SE	Self-Efficacy
SPSS	Statistical Package for Social Sciences
SSB	Sugar-Sweetened Beverage
UPF	Ultra-Processed Food
USDA	United States Department of Agriculture
USMKK	Universiti Sains Malaysia Kampus Kesihatan (Health Campus)

**IMPLIKASI APLIKASI MYFITNESSPAL TERHADAP PANGAMBILAN
KALORI HARIAN DAN PEMILIHAN MAKANAN DALAM KALANGAN
PELAJAR SARJANA MUDA SAINS KESIHATAN DI USM KAMPUS
KESIHATAN (USMKK)**

ABSTRAK

MyFitnessPal (MFP) merupakan alat berfungsi untuk pemantauan diet secara sendiri dan menambah baik pilihan makanan. Namun, kesan MFP terhadap pengambilan kalori dan pilihan makanan dalam kalangan mahasiswa Malaysia masih kurang difahami. Satu kajian pra-pasca intervensi telah dijalankan dalam kalangan pelajar sarjana muda sains kesihatan di USMKK. Peserta merekodkan pengambilan makanan dan minuman harian mereka dengan menggunakan MFP selama 3 minggu, dan purata pengambilan kalori harian telah dikumpulkan. Perubahan dalam pengambilan diet dinilai dengan *Dietary Instrument of Nutrition Education (DINE)*. Ujian-t berpasangan telah digunakan untuk membandingkan pengambilan kalori dan skor makanan DINE. Purata $\pm$ sisihan piawai bagi pengetahuan pemakanan dalam kalangan peserta ialah 15.88 (1.60), dengan 56.4% skor melebihi purata. Selepas penggunaan MFP, 98.7% peserta melaporkan bahawa mereka sedar tentang pilihan makanan mereka melalui perekodan diet. Tiada perbezaan signifikan secara statistik didapati dalam purata pengambilan kalori harian antara Minggu 1 dan Minggu 3. Pengambilan kalori semasa cuti pertengahan semester meningkat secara signifikan daripada minggu kuliah ($p = 0.008$). Skor makanan berlemak adalah signifikannya secara statistik lebih tinggi ($p < 0.001$) selepas penggunaan MFP, manakala perubahan dalam pengambilan makanan bergula, buah-buahan atau sayur-sayuran tidak signifikan secara statistik. Ketiadaan perubahan secara signifikan dalam pengambilan kalori harian menunjukkan kekangan yang dirasakan dari isyarat persekitaran

melebihi manfaat yang dirasakan dari pemantauan sendiri, di mana cuti bertindak sebagai pengganggu yang kuat. Peningkatan secara signifikan dalam skor makanan berlemak mungkin disebabkan oleh bias yang kurang dilaporkan dan kekangan diet. Keputusan yang tidak signifikan untuk kumpulan makanan lain adalah disebabkan oleh kekangan persekitaran universiti. Keputusan kajian ini menunjukkan bahawa walaupun MFP merupakan alat yang berkesan untuk pemantauan sendiri, tetapi ia tidak mencukupi sebagai intervensi sendiri untuk mengubah pilihan makanan mahasiswa. Kajian masa depan boleh mengimplementasikan tempoh intervensi yang lebih panjang atau melengkapi intervensi digital dengan pendidikan pemakanan.

**THE IMPACT OF MYFITNESSPAL ON DAILY CALORIE INTAKE AND
FOOD CHOICES AMONG UNDERGRADUATE HEALTH SCIENCES
STUDENTS IN USM HEALTH CAMPUS (USMKK)**

ABSTRACT

MyFitnessPal (MFP) is a functional tool for dietary self-monitoring and improving food choices. However, the impacts of MFP on calorie intake and food choices in Malaysian university students remain poorly understood. A pre-post interventional study was conducted among undergraduate health sciences students at USMKK. Participants recorded their daily food and beverage intake in MFP for 3 weeks, and average daily calorie intakes were collected. Changes in dietary intake were assessed by using the Dietary Instrument of Nutrition Education (DINE). Paired t-tests were used to compare calorie intake and DINE food scores. The mean $\pm$ standard deviation for the nutrition knowledge among participants is 15.88 ± 1.60 , with 56.4% scoring above the average. After using MFP, 98.7% of students reported becoming aware of their food choices by tracking diet. No statistically significant differences were found in average daily calorie intake between Week 1 and Week 3. Calorie intake during the mid-semester break was significantly higher than during lecture weeks ($p = 0.008$). A significant increase was observed in the fatty food score ($p < 0.001$) after using MFP, while changes in sugary foods or fruit and vegetable intake were not statistically significant. No significant changes in average daily calorie intake suggest that the perceived barriers of environmental cues outweighed the perceived benefits of self-monitoring, where the holiday acted as a strong confounder. The significant increase in the fatty food score may be attributed to the under-reporting bias and dietary restraint. The non-significant results for other food groups are mainly due to the university environment constraints. Results

of this study suggest while MFP is an effective tool for self-monitoring, it is insufficient as a standalone intervention to alter university students' food choices. Future study could implement a longer intervention period or complement digital interventions with nutrition education.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The increasing global incidence of diet-related non-communicable diseases (NCDs) such as obesity, diabetes, and cardiovascular disease highlighted the importance of daily eating behaviours in affecting people's health and well-being. Young adults, especially university students, often find it difficult to maintain a healthy food choice due to high food prices, high academic stress, peer influences, sedentary lifestyles, and limited availability of health foods (Kavii Varma a/l Rajasegaran et al., 2024; Nur et al., 2022; Nur Izzati Syahirah & Norfarizan-Hanoon, 2024; Pitil & Ghazali, 2022). These factors directly and indirectly result in health-related problems such as overweight, obesity, and underweight. Radzi et al. (2019) conducted a study in five of Malaysia's local universities, revealing that the highest percentage of overweight and obesity was found among undergraduate students (23%, 17.6%), followed by Masters (21.9%, 14.3%) and PhD students (17.8%, 18.4%). In Universiti Sains Malaysia health campus, Kubang Kerian, a study reported that out of 125 undergraduate students, 16% were underweight, 19.2% were overweight, and 11.2% were obese (Azhar et al., 2023). This data shows that, although conventional nutrition education can provide basic knowledge, its long-term effects on behaviour changes are often limited.

At the same time, the advancement of mobile health (mHealth) technology and the popularity of smartphones have made health applications (apps) possible. People use mobile devices to look for health-related information with the intention to understand and improve health conditions. When searching the keywords "nutrition" and "diet" in the Google Play Store and Apple App Store in Malaysia settings, the highest downloaded nutrition-related apps available are MyFitnessPal: Calorie Counter, followed by YAZIO

Food & Calorie Counter, Calorie Counter—MyNetDiary, and HealthifyMe—Calorie Counter. While all of these apps allow real-time food records, calorie counting, goal setting, and tracking activity level, MyFitnessPal is the most widely used nutrition and fitness app as it has a larger food database and is country-specific.

Despite there being many mHealth tools available for self-reporting and self-monitoring food-related behaviours, many students remain underinformed about these potential tools for promoting healthier eating habits and are unaware of the need to improve their food choices. As a result, young adults should make use of the internet and digital devices by integrating mHealth apps into their daily lives to adopt healthier lifestyles. While previous studies have explored the impact of MyFitnessPal (MFP) on weight management among vulnerable populations, such as obese people and pregnant women (Banal et al., 2024; Downs et al., 2021; Milwayani Septiyana et al., 2021), its effectiveness in influencing food choices among undergraduate university students remains unclear.

Therefore, this study aims to determine the effectiveness of MyFitnessPal in improving food choices among undergraduate students after using the app for a 3-week period with a pre-post interventional study design. The findings of this study will provide insights into whether self-reporting daily food intake through diet apps can support positive dietary behaviour changes and enhance nutrition intervention and promotion in young adults.

1.2 Problem Statement

Young adults today are increasingly addicted to the internet and smartphones and are often associated with negative dietary practices, such as poor food choices and overeating. With the rise of digital health technologies, mHealth apps have been

introduced to support and assist the adoption of healthy food choices among young adults. A study by Azhar, Vanoh & Ganggaya (2023) reported that out of 125 undergraduate students at Universiti Sains Malaysia Health Campus (USMKK), 16% were underweight, 19.2% were overweight, and 11.2% were obese. Hence, university students should turn their screen time into beneficial habits by using mHealth apps to adopt healthier lifestyle practices. While there are many nutrition-related apps available and related studies targeted on various populations, but the effectiveness of these apps for improving dietary choices among university students is not well-studied. Therefore, this study aims to examine the impact of MFP on food choices among undergraduate health sciences students in USMKK.

1.3 Significance of Study

The findings of this study can provide a new perspective for local nutritional interventions and promote the application of digital health to support healthier eating behaviours in young adults. At national level, this study can contribute data support for policymakers to optimise the initiatives of the National Plan of Action for Nutrition of Malaysia III (NPANM III) 2016-2025 and reduce the incidence of diet-related NCDs. From this study, mHealth apps can be applied to a wider population in the future if they show effectiveness in improving dietary choices. University students can better understand their dietary patterns and needs through the advantages of instant feedback, personalised nutrition recommendations, and data visualisation provided by mHealth apps. For researchers, this study will help in the formulation of new intervention strategies to explore how digital health affects the dietary behaviours of young adults and optimise app design to improve user experience and contribute to long-term behaviour changes.

1.4 Research Questions

- i. What is the average level of nutrition knowledge among undergraduate health sciences students in USMKK?
- ii. What is the proportion of undergraduate health sciences students who are becoming aware of their food choices after using MyFitnessPal in USMKK?
- iii. What is the difference in average daily calorie intake during Week 1 and Week 3 of intervention among undergraduate health sciences students in USMKK?
- iv. What are the changes in the intake of fatty foods, sugary foods, and fruits and vegetables before and after using MyFitnessPal over a 3-week period among undergraduate health sciences students in USMKK?

1.5 Research Objectives

1.5.1 General Objectives

To examine the impact of MyFitnessPal on daily calorie intake and food choices among undergraduate health sciences students in USM Health Campus (USMKK).

1.5.2 Specific Objectives

- i. To determine the average level of nutrition knowledge among undergraduate health sciences students in USMKK.
- ii. To determine the proportion of undergraduate health sciences students who are becoming aware of their food choices after using MyFitnessPal in USMKK.
- iii. To compare the average daily calorie intake during Week 1 and Week 3 of intervention among undergraduate health sciences students in USMKK.
- iv. To assess the changes in the intake of fatty foods, sugary foods, and fruits and vegetables before and after using MyFitnessPal over a 3-week period among undergraduate health sciences students in USMKK.

1.6 Research Hypothesis

1.6.1 Null Hypothesis (H_0)

- i. There is no significant difference in the average daily calorie intake during Week 1 and Week 3 of intervention among undergraduate health sciences students in USMKK.
- ii. There are no significant changes in the intake of fatty foods, sugary foods, and fruits and vegetables before and after using MyFitnessPal over a 3-week period among undergraduate health sciences students in USMKK.

1.6.2 Alternative Hypothesis (H_a)

- i. There is a significant difference in the average daily calorie intake during Week 1 and Week 3 of intervention among undergraduate health sciences students in USMKK.
- ii. There are significant changes in the intake of fatty foods, sugary foods, and fruits and vegetables before and after using MyFitnessPal over a 3-week period among undergraduate health sciences students in USMKK.

1.7 Theoretical Framework

This study is guided by the Health Belief Model (HBM) of behaviour change and it contains six main constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. HBM explains individuals' psychological readiness or intention to adopt a health-related behaviour. Numerous studies have applied the HBM to explain people's health behaviours, help to identify factors affecting eating choices, and develop effective nutrition interventions (Ateş, Özdenk & Çalışkan, 2021; Chang *et al.*, 2022; Cha & Kim, 2023).

In the context of this study, the six key constructs of HBM can be used to explain students' beliefs about whether or not they are at risk for a health concern, and their perceptions of the benefits and costs associated with behaviour change, which influence their intention to take action. Perceived susceptibility is students' perception of whether they are susceptible to health issues related to a poor diet. Individuals who believe they are at low risk of a health problem are less likely to engage in app usage for improving their dietary choices. Perceived severity is the degree to which individuals believe that unhealthy food choices can lead to significant personal or social consequences. If they perceive their current food choices are unbalanced and may increase the risk of negative health effects, they are more likely to adopt the use of mHealth apps. Next, students who perceive the use of MyFitnessPal as beneficial in supporting them to make healthier food choices to improve their health will use the app consistently. In order for behaviour change to occur, people should overcome any barriers to using the app effectively, such as lack of motivation, burden of food logging, and time constraints. Thus, perceived benefits should outweigh the perceived barriers to maintain a new behaviour. Cues to action refer to any cue or factor that reminds and encourages students to engage with the app and make healthier dietary choices. Self-efficacy refers to an individual's ability to confidently make and maintain healthy food choices successfully with the help of the app.

By applying HBM, this study aims to explore how MyFitnessPal can influence students' perceived health risks, create motivation for balanced diets, and enhance their understanding of healthy food choices.

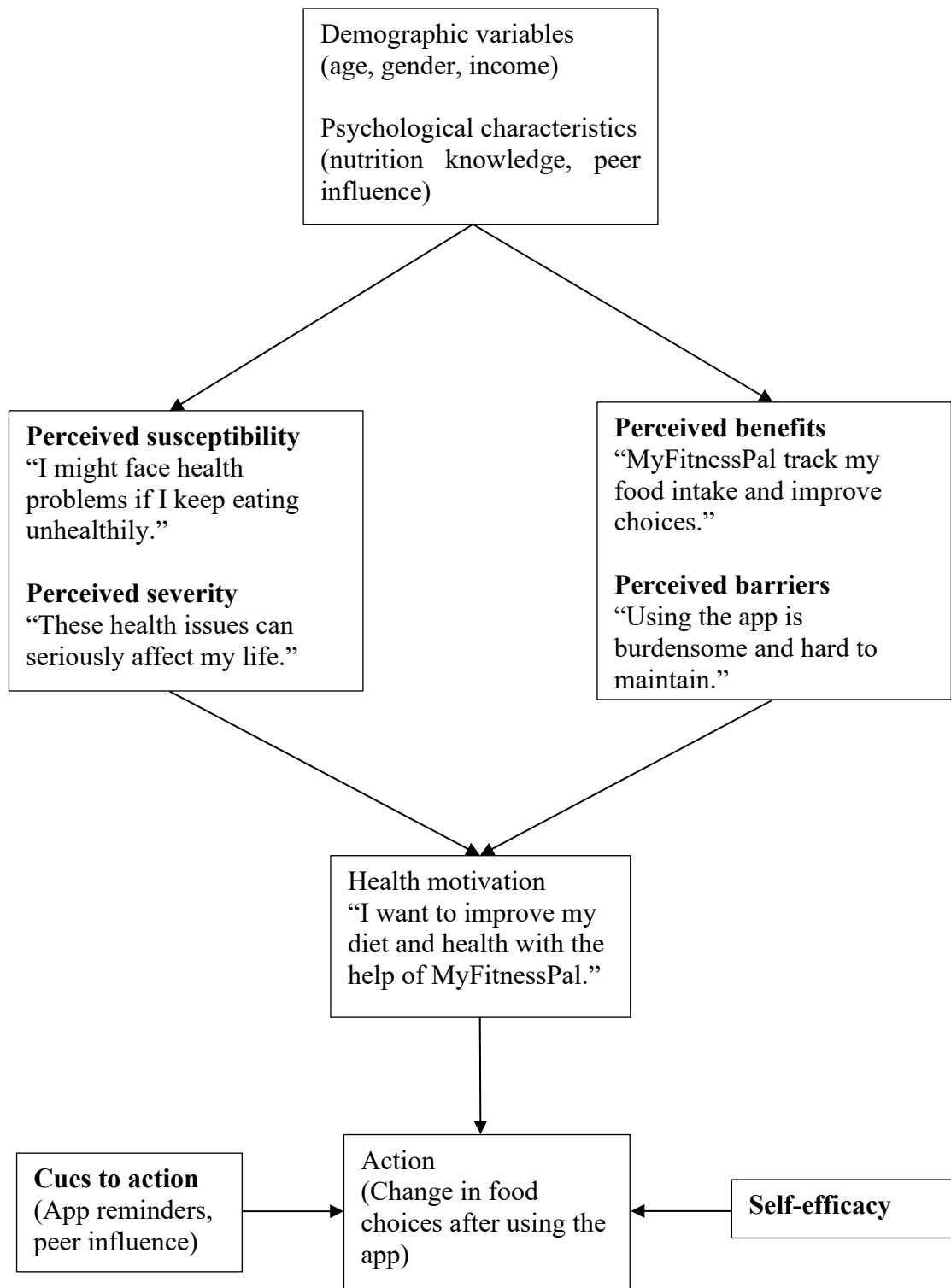


Figure 1.1 Application of the Health Belief Model (HBM) in a Mobile Health Intervention to Improve Dietary Choices

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to the Research Problem

Food choices, or dietary choices, are complex and result from an interaction of many factors including the changes in food systems, biological factors, physical requirements, lifestyles, and development of technology (Chen & Antonelli, 2020). As young adults transition from parental monitoring to independent living, especially from secondary school into a university environment, they need to be more responsible for their food choices. Interestingly, a study by Georgiou et al. (1997) found that college students and graduates tend to practice more healthful lifestyles and perform better food choices than non-students. However, few studies have reported the ‘freshman effect’, which is the weight gain during the first year of university (Vilaro *et al.*, 2018; Lorenzoni *et al.*, 2021). In 2023, a study reported out of 125 undergraduates, 16% were underweight, 19.2% were overweight, and 11.2% were obese in the Universiti Sains Malaysia (USM), Health Campus (Azhar, Vanoh & Ganggaya, 2023).

Concurrent with these health concerns is the growing prevalence of mobile technology use among young adults. Fook et al. (2021) reported that university students were the most active users of smartphones, with bachelor’s degree students responding the most in the study, and their main purposes being to access the internet and social media. While this trend becomes concerns, it also presents an opportunity to turn screen time for beneficial habits through mHealth apps, rather than scrolling on social media. mHealth refers to the use of mobile and wireless technologies to achieve public health objectives (World Health Organization, 2011). With advancements in digital health and growing awareness of personal well-being, mHealth apps have become widely available,

being used for a variety of health purposes and supporting people across the lifespan (Grundy & Bloomberg, 2021).

Despite the availability of many mHealth apps, there remains a gap in understanding their effectiveness in influencing positive behaviour change, particularly in improving nutrition and dietary choices among university students. Therefore, this study aims to explore whether turning passive screen time into active health initiatives through a nutrition-related mHealth app, namely MyFitnessPal, can lead to healthier food choices among undergraduate students at USM Health Campus.

2.2 Current Food Choices among University Students

2.2.1 Dietary Habits, Trends and Their Impacts among University Students

Dietary habits are established since childhood and continue into adulthood, which may influence food trends and nutritional health in the society (Montaño *et al.*, 2015). Food choices play an important role in determining an individual's nutritional status and physical performance (Nafilla, Dewi & Ellyas, 2023). For university students, food choices are shaped by more than just beliefs in nutrition and health but are also influenced by emotional states, physical appearance, convenience, price, time and the food environment (Lambert, Chivers & Farringdon, 2019). Studies revealed that students often eat out, skip meals, or choose fast foods due to a lack of cooking skills or living away from home (Lambert, Chivers & Farringdon, 2019). This eating pattern has been associated with weight gain (Deliens *et al.*, 2019), lower academic achievement (Burrows *et al.*, 2017), and increased risk of mortality (Clark *et al.*, 2019).

The increasing prevalence of obesity and overweight among university students is often attributed to the overconsumption of calories due to high-fat and -sugar foods,

alongside low intake of vitamins, minerals and other micronutrient-rich foods, such as milk, fruits and vegetables (Deshpande, Basil & Basil, 2009; Afari-Sefa *et al.*, 2016). Another research by Sogari *et al.* (2018) also indicated that poor eating habits contribute to weight gain, mainly caused by irregular mealtime, unhealthy snacking, and overeating. Many students' diets are lacking essential nutrients (e.g., vitamins and minerals) due to a preference for fast foods, processed snacks, and sugar-sweetened beverages (SSBs) (Almoraie *et al.*, 2024).

Another common issue among university students is skipping meals, especially breakfast. Javeed *et al.* (2021) found that many students skip breakfast regularly, mostly 3 to 4 times per week. In the study, students often claimed that meal skipping is due to busy schedules and academic stress. Snacks are defined as foods consumed outside of meal and often include beverages (Johnson & Anderson, 2010). A study found that most students consumed both confectionery and savoury chips at least once a week, whereas healthier snacks (such as nuts, fruits and muesli) were rarely consumed (Roy *et al.*, 2019). Roy *et al.*, 2019 also found staying up late to study caused students to consume high-calorie foods such as pizza, chips and ice cream, leading to weight gain and poor sleep quality. Globally, the consumption of sugar-sweetened beverages (SSBs) remains high, particularly among adults aged 20–39 (Singh *et al.*, 2015). Several studies in Malaysia also found that the majority of the students consumed SSBs daily (Ahmad *et al.*, 2019; Abu Bakar *et al.*, 2020; Cheah *et al.*, 2023).

Although university students are often associated with unhealthy food choices, a number of studies showed that a large percentage of them eat healthy foods regularly. A review by Almoraie *et al.* (2024) showing that many students, highlighted in Malaysia, Lebanon, and China, regularly consumed healthy meals. Specifically in Malaysia, 60%

of students reported eating balanced meals, 81.8% frequently consumed vegetables and legumes, and 48.5% ate fruits at least three times per week (Ganasegeran *et al.*, 2012). Almoraie et al. (2024) also summarize that female students are more likely to choose healthy foods, while male students are more likely to consume fast food overall. Conversely, Fryar et al. (2018) indicated that young women tend to consume chocolate more often than men and choose fast food as a snack.

2.2.2 Determinant of Food Choices

According to the Contento's Framework, people's food choices are influenced by 4 interrelated factors, namely biologically determined behavioural predispositions, experience with food, person-related determinants, and social and environmental determinants (Contento, 2011). These determinants are interconnected and sometimes do not have clear boundaries, making food choices complex and influenced by multiple overlapping factors.

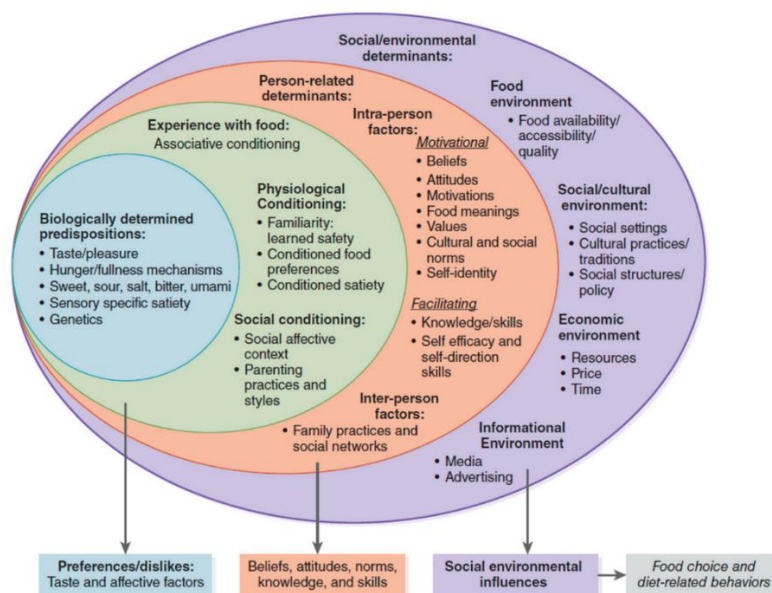


Figure 2.1 Determinants of Food Choices (Contento, 2011)

2.2.2(a) Biologically determined predisposition and personal experience with food

A study found that university students used to not include fruits, vegetables and fish in their meals because they reason not appealing tastes (Lorenzoni *et al.*, 2021). Food factors such as food appearance and its nutrient content contribute to biologically determined preferences towards certain foods (Shepherd, 1989). Individuals develop distinct experiences regarding a particular food, thus leading to different kinds of beliefs about the food, such as the taste of the food or the perceived healthiness. Razali *et al.* (2014) reported that, even though external factors such as food price and convenience also influence people's food choices, they are considered less influential as compared to taste preferences and health beliefs.

Psychological factors play a significant role in shaping an individual's food choices, and many of these influences stem from personal experiences with food (Razali *et al.*, 2014). These include attitudes toward both familiar and unfamiliar foods, as well as emotional states that affect eating behaviours (Roininen *et al.*, 2001). One key psychological behaviour related to food experience is food neophobia, defined as the reluctance to try new or unfamiliar foods (Razali *et al.*, 2014). Moderately hungry people tend to show a lower level of food neophobia compared to when they are full or not hungry (Pliner, Eng & Krishnan, 1995), thus they tend to be less selective regarding food choices. In addition, emotions significantly influence food choices. Studies have shown that different moods trigger cravings for specific types of food. For instance, people tend to eat sweets when they are happy or feeling stressed and may seek variety when bored (Babicz-Zielińska, 2006).

2.2.2(b) Person-related determinants

Intrapersonal factors are factors related to an individual's self, thoughts, and internal processes.

In a qualitative study, university students mentioned that their food choices are largely driven by body image, not health, especially in females (Lambert, Chivers & Farrington, 2019), highlighting the influence of self-consciousness on food behaviours. Academic stress is another intrapersonal factor that shapes students' dietary habits (Nur *et al.*, 2022). According to Papier *et al.* (2015), university students tend to take pleasure in strongly tasted and calorie-dense foods or snacks when they feel stressed as a coping mechanism. As compared to healthy foods, stress tends to increase the intake of high-calorie snacks, sugary foods, sweets, and carbohydrate-rich foods (Zellner, Saito & Gonzalez, 2007; Mikolajczyk, El Ansari & Maxwell, 2009; Choi, 2020). Moreover, self-motivation plays a significant role in determining what people eat. According to a study by Menozzi, Sogari & Mora (2015), young adults in Italy lack motivation in food preparation, which is related to the consumption of less healthy foods. A study among Canadian university students reported healthy eating is believed to be helpful in providing a healthy appearance, thus providing positive feelings, and preventing disease (Deshpande, Basil & Basil, 2009).

Interpersonal factors are elements that shape interactions and relationships between individuals.

Parents have a crucial role in shaping the concept of healthy eating among their children, both positively and negatively (Sogari *et al.*, 2018). The study found that students living at home had healthier diets while those living independently or with peers more likely to eat unhealthily (Lambert, Chivers & Farrington, 2019). Similarly, Mills *et*

al. (2017) found that people who prepare home-cooked foods are more likely to make better choices while eating. Peer support plays an important stimulus for students to practice healthy eating (Sogari *et al.*, 2018). A focus group study indicated that when students live together with peers, they are more aware of the food they eat and greater chance of cooking healthy meals (Deliens *et al.*, 2014). However, the same study also found peer pressure becomes a barrier to healthy eating. A natural experiment on peer influence and weight found that students tended to gain less weight during their freshman year if their roommates started with a higher body weight (Contento *et al.*, 2006), suggesting that peers can both positively and negatively affect each other's eating behaviours.

2.2.2(c) Social and environmental influences

Food security falls under the food and economic environment domains under social and environmental determinants. Studies found that food-insecure adults had a significantly higher prevalence of obesity (Pan *et al.*, 2012), often attributed to the affordability of energy-dense foods such as refined carbohydrates and fat to fulfil their calorie requirement (Morales & Berkowitz, 2016). However, other studies found that food security status is not associated with weight status among university students (Knol *et al.*, 2017; Ukegbu *et al.*, 2019; Nur Izzati Syahirah & Norfarizan-Hanoon, 2024).

Sajwani *et al.* (2009) discovered that limited financial resources and lack of time were the barriers for university students to skip meals and regular exercise. They often report healthy foods are too expensive, adaptation of a new environment, poor time management and limited cooking skills increase the likelihood of eating out or choosing processed foods (Sajwani *et al.*, 2009; Sousa *et al.*, 2020). The study is in line with findings by Munt, Partridge & Allman-Farinelli (2017) where students reported that lack

of time, limited facilities, and availability of unhealthy foods were the main barriers to healthy eating.

Socio-cultural norms such as weight concerns also play a role in shaping people's dietary choices (Downs *et al.*, 2021). A study by Sulaiman & Pei Sin (no date) found that weight control ranked among the top reasons for food selection, especially among females, who were generally more conscious of their weight compared to males. Cultural practices are also reflected in cooking methods and the use of seasoning, which influences students' food choices (Mary W. Murimi *et al.*, 2016). In line with the findings, studies found that adolescents and young adults tended to prefer fried foods (Campbell, 2009; Wang *et al.*, 2010).

Social media and influencers have become a place where anyone can share information regarding nutrition without being a certified dietician or nutritionist, shaping people's dietary choices (Ahmad & Bruno, 2021; Granheim *et al.*, 2022). A qualitative study by Lambert, Chivers & Farrington (2019) revealed that students are passively exposed to nutrition information via social media, without intentionally seeking it out. Social media both positively and negatively influences students' food choices (Tan, Pereira & Yusoff, 2024). On the positive side, it promotes healthier food choices through the sharing of healthier recipes and creative ways to cook, encouraging more fruits and vegetables, and reducing sugar intake. On the other hand, social media may trigger unhealthy dietary habits through delicious-looking food videos and food promotions, as well as distraction while eating (Vaterlaus *et al.*, 2015).

2.2.3 Level of Nutrition Knowledge

To achieve healthy eating, consumers must have some basic knowledge about food, healthful products, and the composition of a balanced meal (Sogari *et al.*, 2018).

The extent of one's nutritional knowledge can influence their food choices, portion sizes, overall eating habits, and risk of developing eating disorders. For example, individuals with strong nutrition knowledge are more capable of making informed dietary decisions, interpreting food labels, meeting nutrient needs, and distinguishing between healthier and less nutritious food options (Nizal *et al.*, 2024). Lack of dietary knowledge and skill to make healthful food choices as well as to prepare healthy foods, serve as a barrier to adopting a healthy college or university life (Cluskey & Grobe, 2009). Studies showed that students with a better understanding of food, lifestyle and nutrition, are more likely to practice better lifestyles (Kavii Varma a/l Rajasegaran *et al.*, 2024).

However, knowledge alone is not sufficient and can be difficult to put into practice. Findings from a qualitative study revealed that university students know the dietary guidelines, but they choose not to follow the guidelines because they perceive these guidelines and the outcomes of unhealthy eating are irrelevant to them (Lambert, Chivers & Farrington, 2019). A similar finding was reported in the study by Deshpande, Basil & Basil (2009), where knowledge did not significantly influence college students' food choices, even among individuals who possessed that knowledge. As a result, the university needs to provide food education and food preparation, to make students more knowledgeable and make proper food choices (Sogari *et al.*, 2018).

2.2.4 Challenges in Maintaining a Healthy Diet in University Setting

Whether students living on-campus and off-campus make different food choices (Brevard & Ricketts, 1996). According to Almoraie et al. (2024), food environments consist of the collective physical, policy, economic and social factors that influence individual's decisions regarding what to eat and drink, as well as their nutritional status.

University food environments are usually dominated by unhealthy food choices with very limited healthy options and present various barriers to healthy eating (Tam *et al.*, 2017). Firstly, the campus was predominantly loaded with energy-dense, nutrient-poor foods that were more accessible, heavily promoted, and more affordable than the healthier alternatives (Roy *et al.*, 2019). Additionally, studies have shown that these environments tend to encourage the consumption of ultra-processed foods (UPFs) and drinks (Roy *et al.*, 2016).

In addition, the university campus is also filled with vending machines, which are commonly found throughout university environment. A study by Roy *et al.* (2019) revealed that only 1 out of 29 vending machines on the campus was considered healthy, and the remaining primarily sold unhealthy snacks. Studies from several countries found that 49% to 100% of vending machine products were nutritionally poor (Matthews & Horacek, 2015; Grech *et al.*, 2017; Whatnall *et al.*, 2020), which is associated with increased snack consumption for busy students and staffs (Grech *et al.*, 2017). Healthier options were limited, more expensive, and poorly marketed.

2.3 Role of Mobile Health (mHealth) apps

2.3.1 Growth, Impacts and Limitations of mHealth Apps

The number of health applications (apps) available on commercial app stores (such as Google Play Store and Apple App Store) has rapidly increased since the past decade. These apps are targeted at users across their lifespan, centred around health promotion, disease prevention, and chronic disease management (Grundy & Bloomberg, 2021). mHealth interventions are generally instruments for self-monitoring and self-management, primarily grounded in behavioural change theories (BCTs), which serve as the active motivators that drive user outcomes (Grundy & Bloomberg, 2021). This finding

is in contrast to previous research, which discovered that the majority of health apps lacked theoretical underpinnings to support successful and long-lasting behavioural changes (Breton, Fuemmeler & Abrams, 2011; West *et al.*, 2012).

Meta-analyses of randomised controlled trials (RCTs) on mobile health apps revealed that these interventions did result in small to moderate improvements, such as reductions in sedentary behaviour, anxiety, and postpartum depression (Grundy & Bloomberg, 2021). However, their effectiveness in promoting physical activity and aiding smoking cessation remains limited or unclear (Firth *et al.*, 2017; Grundy & Bloomberg, 2021). In addition, a Korean study evaluated 29 widely recognized diet-related mobile apps to examine how well they support healthier food choices (Choi, Chung & Woo, 2021). The study found that while most apps offer basic features like calorie tracking, they lack reward systems, personalised feedback, and dynamic behaviour change tools. From the same study, it is noteworthy that app popularity metrics are found to conflict with professionals' evaluations, with some of the most downloaded and highly rated apps lacking validated quality indications.

Numerous studies have demonstrated the effectiveness of mHealth apps in promoting weight loss and healthier eating habits (Turner-McGrievy *et al.*, 2013; West *et al.*, 2013, 2017; Smith *et al.*, 2014; Struempier *et al.*, 2014), and they may be useful instruments for weight management and assisting adherence to dietary interventions (Carter *et al.*, 2013). A study indicated that the ability of mobile apps to assess dietary intake, physical activity, tracking blood glucose level, and the overall achievement of patients' health goals was one of the most positive feedback reported by clinicians working with diabetic patients (Karduck & Chapman-Novakofski, 2018). In the study,

the clinicians stated that MyFitnessPal (MFP) was one of the most recommended and widely used diet-tracking apps.

Despite the vast production of mHealth apps, several studies indicate that the majority of them only have basic features, primarily focused on providing information, tracking, and self-monitoring tools, but more comprehensive features like meal planning, personalised feedback, and professional access remain uncommon, especially in free versions (Wasil *et al.*, 2019; Choi, Chung & Woo, 2021; Portenhauser *et al.*, 2021). Studies also revealed that app users appreciate tracking and self-monitoring features for a sense of control over their health (Firth *et al.*, 2017; Slater *et al.*, 2017; Lupton, 2018), but these can trigger negative feelings like guilt, avoidance, resentment, or lower self-confidence when users fail to meet personal health goals (Ancker *et al.*, 2015; Nicholas *et al.*, 2017; Parker *et al.*, 2018).

2.3.2 Nutrition-Related Mobile Apps and MyFitnessPal

Most nutrition-related mobile apps feature nutritional assessment through food records or food diaries, providing users feedback on calories and macronutrient (carbohydrate, protein, and fat) intake (Franco *et al.*, 2016). Food intake is usually logged by users manually searching food items or scanning barcodes, with serving sizes selected using units (such as grams) or household measures (such as cups, teaspoons). Food inputs are divided by either meals (breakfast, lunch, dinner) or snacks. According to Carter *et al.* (2013), individuals who used smartphone apps for dietary self-monitoring reported much higher adherence rates compared to those who used paper-based tracking. This is because the use of mobile nutrition apps may reduce user burden by eliminating the need for manual calorie calculations and carrying around a calorie book and paper diary (Turner-McGrievy *et al.*, 2013).

MyFitnessPal (MFP) is a smartphone application designed by MyFitnessPal, Inc. in 2005 and was purchased in 2015 by Under Armour, and in 2020, Under Armour sold it to the Francisco Partners, a private equity firm. In 2021, MyFitnessPal partnered with Sprouts Farmers Market, introducing new healthy recipe ideas, food and health-related articles, and other content (Acosta, 2021). This app is free to use by users both smartphones with Android (Google Play Store) and iOS (Apple App Store) operating systems.

MFP remains one of the most popular diet-tracking apps, with over 100 million downloads recorded on the Android Google Play Store in April 2025. When compared to the U.S. Department of Agriculture (USDA) food database, MFP has demonstrated excellent consistency and accuracy in estimating calories and macronutrients when compared to USDA reference data (Nurwanti & Bai, 2019). This is further supported by evidence showing MFP is valid and efficient for estimating total energy, macronutrients, fibre and sugar intake, but not for cholesterol and sodium when compared to the food composition database Nubel (Evenepoel *et al.*, 2020). However, a more recent study by Evenson & Berens (2021) found that MFP tends to underestimate values for energy, fat, carbohydrates, and sodium compared to the ESHA-Food Processor software.

Franco *et al.* (2016) also compared 13 popular nutrition-related apps (including S Health, FatSecret, Lose it!, Lifesum, MyFitnessPal and others) and discovered that, compared to other widely used nutrition apps, MFP offers additional features by providing educational tips (such as “this food is high in protein”). The app also allows users to create and save custom meals or recipes by combining existing food items within the app. According to a study by Nurwanti & Bai (2019) conducted in Taiwan and Indonesia, MFP includes a variety of food databases that feature not only Western foods

but also local Asian foods, making it a potent diet-tracking tool across countries. Since other useful apps such as LifeSum and MyPlate are not as popular in Malaysian app stores, MFP is considered the most suitable application to be implemented this study.

2.3.3 Interventional Studies and Effectiveness of MyFitnessPal

Studies conducted in Indonesia have shown a significant reduction in energy and sugar intake from SSBs and an improvement in iron and calcium intake among overweight and obese college students with the combination of nutrition counselling and the use of MFP for 2 weeks (Milwayani Septiyana *et al.*, 2021; Nuryandini *et al.*, 2022). These findings are consistent with a study by Laing *et al.* (2014) wherein participants in a randomized controlled trial (RCT) reported that using MFP increased their awareness of portion sizes and dietary choices. Similarly, Hahn, Linxwiler, *et al.* (2021) conducted RCT followed by an interview among undergraduate women and reported that MFP assisted students make more mindful food choices, as they took more time to consider what to eat.

MFP serves as both a potentially beneficial and detrimental tool when it comes to dietary self-monitoring. For instance, apps like MFP may be used as low-intensity tools to assist weight loss, support self-monitoring, and improve dietary behaviour when they are aligned with behavioural theories such as Social Cognitive Theory (SCT) (Patel *et al.*, 2019). However, without adequate clinical supervision, such tools may also harm individuals' mental health, especially for those at risk of eating disorders (McCaig *et al.*, 2020). A qualitative study found that implementing MFP for dietary monitoring caused both positive and negative feelings among undergraduate women. While they felt better and prideful when eating within daily calorie and macro recommendations, MFP increased their self-consciousness about food choices, body shape, and weight, making them feel guilty and concerned (Hahn, Kaciroti, *et al.*, 2021).

2.4 Health Belief Model

2.4.1 Overview of the Health Belief Model (HBM)

The Health Belief Model (HBM), developed in the 1950s by a group of U.S. Public Health Service social psychologists, is one of the most widely used frameworks to explain and predict health-related behaviours (Rosenstock, 1974). The model initially comprised four main constructs: perceived susceptibility and severity, as well as the perceived barriers and benefits associated with engaging in certain behaviours (Rosenstock, 1974). A decade later, the model added two cognitive constructs to enhance the explanatory power of traditional HBM, namely self-efficacy and cues to action (Rosenstock, 1974; Janz & Becker, 1984; Rosenstock, Strecher & Becker, 1988). Finally, HBM assumes that demographic, socio-psychological, and structural variables might influence individual perceptions and shape how the benefits of preventive actions are evaluated and that largely remains unchanged (Rosenstock, 1974). General speaking, HBM addresses the individual's psychological readiness to take action by determining the perceptions of the threat (susceptibility, severity) posed by a health problem, the benefits of avoiding the threat, and factors influencing the decision to act (barriers, cues to action, and self-efficacy) (Maiman & Becker, 1974; National Cancer Institute, 2005).

The HBM also assumes that motivation is essential for action, influencing how individuals perceive threats and benefits (Rosenstock, 1966; Maiman & Becker, 1974). Motivation is expressed through two dimensions: the readiness to act and the belief in the effectiveness of the action. Becker, Drachman & Kirscht (1974) proposed expanding the model by introducing a separate construct, named general health motivation, which reflects an individual's overall desire to achieve or maintain health or 'readiness to be concerned about health matters' (Abraham, 2015). This motivational factor, along with incentives and expectations, collectively contributes to the "disposition to act," and their

interaction can have a multiplicative effect, meaning all factors must align to effectively drive behaviour change.

Perceived susceptibility

Susceptibility refers to the subjective vulnerability of contracting a condition. According to Rosenstock (1974), individuals have a wide variation in their acceptance of personal susceptibility to a condition. If a person feels that he or she is in real danger of contracting the condition, he/she is more likely to take action to avoid the condition, compared to those who deny any or admit a certain possibility of disease occurrence. Therefore, the higher the perceived susceptibility, the more likely the individual will take health-preventive action to reduce the possibility of contracting an illness. In this study, students' perceived susceptibility is the likelihood of facing a health problem if poor food choices remain unchanged.

Perceived severity

The perceived severity of a given health problem may also vary from person to person. It is the degree of seriousness of contracting a condition. It may be influenced by both the evaluation of emotional arousal (such as social relations, psychological or economic tension) created by the health condition, as well as by the possible physical consequences (such as reduced functioning, disability or death) the individual believes he would face due to a problem (Rosenstock, 1974). In combination, perceived susceptibility and severity provide a measure of the degree of perceived threat (perceived risk) associated with the health condition. In this study, perceived severity is the student's perception of the consequences of the health issues resulting from unhealthy eating, such as declined academic performance, disturbed social relationships or pain.

Perceived benefits

Whether a person will change their behaviours depends on how beneficial they believe the changes would be in their case (Rosenstock, 1974). A behaviour change is seen as beneficial if it relates subjectively to the reduction of one's susceptibility or to severity of an illness (Rosenstock, 1966). It is focused on the person's beliefs about the availability and effectiveness of the change of action, but not the objective facts about the effectiveness of action. An individual's perceived benefits must be stronger than perceived barriers in order to have the health-protective behaviour change to occur (Rosenstock, Strecher & Becker, 1988). In this study, if students believe that MFP is effective in improving food choices and leads to overall well-being by overcoming the perceived barriers, they are likely to adopt new behaviours.

Perceived barriers

Although an individual may believe that a given action may be effective in reducing the threat of a disease, at the same time there are negative aspects that serve as barriers to behaviour change (Rosenstock, 1974). This may include inconvenience, unpleasantness, pain, money lost or upset that the action is thought to bring up. If the readiness to change was low while the potential negative aspects were seen as strong, the action was not likely to be taken, and vice versa. Barriers for students to use the MFP app to improve dietary choices may include lack of time or motivation and environmental factors.

Cues to action

Factor that serves as a cue, or trigger, to appropriate action is necessary for behaviour change to occur, this kind of factor is called a cue to action. Even a high perceived susceptibility, severity, and benefits may not lead to behaviour change without an external or internal stimulus to activate the decision-making process. An internal cue