UNIVERSITI PUTRA MALAYSIA

NEEDS ASSESSMENT AND DEVELOPMENT OF INTERVENTION TO IMPROVE FOOD SAFETY BEHAVIOR AMONG FOOD HANDLERS IN SELECTED SCHOOL CANTEENS IN THE KLANG VALLEY, MALAYSIA

STEPHENIE WONG YOKE WEI

FSTM 2021 18

NEEDS ASSESSMENT AND DEVELOPMENT OF INTERVENTION TO IMPROVE FOOD SAFETY BEHAVIOR AMONG FOOD HANDLERS IN SELECTED SCHOOL CANTEENS IN THE KLANG VALLEY, MALAYSIA

By

STEPHENIE WONG YOKE WEI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

February 2021

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

NEEDS ASSESSMENT AND DEVELOPMENT OF INTERVENTION TO IMPROVE FOOD SAFETY BEHAVIOR AMONG FOOD HANDLERS IN SELECTED SCHOOL CANTEENS IN THE KLANG VALLEY, MALAYSIA

By

STEPHENIE WONG YOKE WEI

February 2021

Chair : Y.M. Ungku Fatimah binti Ungku Zainal Abidin, PhD
Faculty : Food Science and Technology

In Malaysia, the number of foodborne outbreaks in schools has increased over the years. One of the main contributing factors is the improper handling of food among food handlers. The study aimed to develop an intervention to improve two selected food safety behaviors (handwashing and preventing contamination of ready-to-eat food) among food handlers at public school canteens. An-extended Health Action Model (HAM) was used as a framework to conduct a needs assessment, using a mixed-method approach comprising of focus group, survey and direct observation. A total of seven focus group discussions with food handlers (n=64) were first carried out to identify their perceived barriers and motivation to perform handwashing and preventing food contamination, which were used as part of the instrument adaptation and validation process. This was followed by a baseline survey (n=211) on food handlers' knowledge, belief, norm, motivation, habit, and behavioral intention according to the HAM constructs. The proposed research model extends HAM by incorporating five dimensions of beliefs (i.e., self-efficacy, perceived susceptibility, severity, barriers, and benefits) and four dimensions of motivation (law and enforcement, reward, internal motivation, and resources). Analysis using PLS-SEM (v3.0) revealed that norm and knowledge significantly influenced belief, ultimately affecting food handlers' intention to perform handwashing practices ($p \leq 0.001$). Instead, the intention-behavior relationship, specifically for contamination prevention, was not supported in this study ($p > 0.05$). Importance and Performance Matrix Analysis (IPMA) revealed that self-efficacy was identified as a priority variable to focus on the development of the intervention. An educational intervention program focusing on enhancing self-efficacy was developed and tested using a treatment group (n=31) and a control group (n=30). The effectiveness of the intervention package was evaluated after a 14-day intervention period. The intervention program produced a significant increase ($p < 0.001$) in the behavioral compliance, knowledge and self-efficacy scores. Even though there are rooms for improvement, the post-intervention handwashing compliance score shows an increase in the overall frequency of soap use and compliance with the correct handwashing technique among the participants. Findings from this study provide

valuable information on the possible use of the HAM model to develop a customized food safety educational program to improve food safety behavior among school food handlers. This study is the first one known to test the HAM using observational food safety behavioral data empirically. Future studies should focus on identifying other variables that may bridge the intention-behaviour gap, especially for contamination prevention.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PENILAIAN KEPERLUAN DAN PEMBANGUNAN INTERVENSI BAGI MEMPERBAIKI AMALAN KESELAMATAN MAKANAN DI KALANGAN PENGENDALI MAKANAN DI KANTIN SEKOLAH TERPILIH DI SEKITAR LEMBAH KELANG, MALAYSIA

Oleh

STEPHENIE WONG YOKE WEI

Februari 2021

Pengerusi : Y.M. Ungku Fatimah binti Ungku Zainal Abidin, PhD
Fakulti : Sains dan Teknologi Makanan

Di Malaysia, bilangan kes keracunan makanan di sekolah semakin meningkat beberapa tahun kebelakangan ini. Salah satu penyumbang utama adalah pengendalian makanan yang tidak betul di kalangan pengendali makanan. Kajian ini bertujuan untuk menbangunkan intervensi bagi memperbaiki dua tingkah laku keselamatan makanan terpilih (mencuci tangan dan mencegah pencemaran makanan yang sedia dimakan) di kalangan pengendali makanan di kantin sekolah awam. Model 'Health Action Model (HAM)' yang diperluaskan digunakan sebagai kerangka untuk melakukan penilaian keperluan, dengan menggunakan kaedah pendekatan campuran yang merangkumi perbincangan kumpulan fokus, kajian soal-selidik dan pemerhatian secara langsung. Sebanyak tujuh perbincangan kumpulan fokus dengan pengendali makanan (n=64) telah diadakan terdahulu bagi mengenal pasti kepercayaan halangan dan motivasi mereka untuk mengamalkan tingkah laku yang terpilih. Hasil perbincangan kumpulan fokus digunakan untuk proses penyesuaian dan pengesahan instrumen. Ini diikuti dengan soal selidik garis dasar (n=211) berkenaan pengetahuan, kepercayaan, norma, motivasi, kebiasaan, dan niat tingkah laku pengendali makanan berasakan kesemua konstruk HAM. Model yang dicadangkan ini memperluaskan HAM dengan memasukkan lima dimensi kepercayaan (iaitu efikasi kendiri, kerentanan, keparahan, halangan, dan faedah) dan empat dimensi motivasi (undang-undang dan penguatkuasaan, ganjaran, motivasi dalaman, dan sumber). Analisis menggunakan PLS-SEM (v3.0) menunjukkan bahawa norma dan pengetahuan secara signifikan mempengaruhi kepercayaan yang akhirnya mempengaruhi niat pengendali makanan untuk melakukan amalan mencuci tangan ($p \leq 0.001$). Sebaliknya, hubungan niat-tingkah laku khusus untuk pencegahan pencemaran tidak disokong dalam kajian ini ($p > 0.05$). Analisis Matriks Kepentingan dan Prestasi (IPMA) mendedahkan bahawa keberkesanan diri dikenal pasti sebagai pemboleh ubah keutamaan yang harus diberi tumpuan untuk pembangunan intervensi. Program intervensi pendidikan yang memfokuskan pada peningkatan efikasi kendiri dibangunkan dan diuji menggunakan kumpulan rawatan (n=31) dan kumpulan kawalan (n=30). Kedua-dua kumpulan dinilai

sebelum dan selepas tempoh intervensi 14 hari. Program intervensi menghasilkan peningkatan yang signifikan ($p < 0.001$) dalam kepatuhan tingkah laku, pengetahuan dan skor efikasi kendiri. Walaupun terdapat ruang untuk penambahbaikan, skor pos-intervensi kepatuhan pencucian tangan menunjukkan terdapat peningkatan dalam frekuensi penggunaan sabun dan pematuhan terhadap teknik mencuci tangan yang betul di kalangan peserta. Hasil kajian ini memberi maklumat yang berharga mengenai penggunaan model HAM dalam pembangunan program pendidikan keselamatan makanan yang khas untuk meningkatkan tingkah laku keselamatan makanan pengendali makanan sekolah. Kajian ini adalah yang pertama yang diketahui menguji HAM secara empirik, dengan menggunakan data tingkah laku keselamatan makanan pemerhatian secara langsung. Kajian masa depan harus memberi tumpuan kepada pengenalpastian pembolehubah lain yang boleh merapatkan jurang niat-tingkah laku, terutamanya untuk pencegahan pencemaran.

ACKNOWLEDGEMENTS

I wish to express my heartfelt appreciation to those who have supported me during this PhD journey. It has been a challenging, exciting, and laborious journey. First and foremost, my deepest gratitude goes to my research project supervisor, Y.M. Dr. Ungku Fatimah binti Ungku Zainal Abidin for her invaluable advice, guidance and support. Without her kindness, endless encouragement and reassurance, this thesis would not have been made possible. I am also highly indebted to both my co-supervisors, Assoc. Prof. Dr. Ho Jo Ann and Assoc. Prof. Dr. Nor Ainy binti Mahyudin for their technical input and concrete advice for improvement throughout the process.

Special thanks go to the Ministry of Education Malaysia, the State Education Department, and the school authorities for allowing this study to be conducted in selected schools. I would also like to thank all the content experts and participants for sparing their time to provide the required feedback and information. I am also thankful to Izzah, Anis, Xin Jean, friends and colleagues who have helped me in one way or another during this journey. Last but not least, I am grateful to my family for their love and support.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Y.M. Ungku Fatimah binti Ungku Zainal Abidin, **PhD**
Senior Lecturer
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

Nor Ainy binti Mahyudin, PhD
Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

Ho Jo Ann, PhD
Associate Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Member)

_____
ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 10 June 2021

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/ fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____ Date: _____

Name and Matric No.: Stephenie Wong Yoke Wei (GS40617)

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____
Name of Chairman of
Supervisory Committee: Y.M. Ungku Fatimah binti Ungku Zainal Abidin

Signature: _____
Name of Member of
Supervisory Committee: Nor Ainy binti Mahyudin

Signature: _____
Name of Member of
Supervisory Committee: Ho Jo Ann

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CR	Composite Reliability
EFA	Exploratory Factor Analysis
FDA	US Food Drug and Administration
FGD	Focus Group Discussion
HAM	Health Action Model
HBM	Health Belief Model
HTMT	Heterotrait-Monotrait Ratio of Correlations
KAP	Knowledge, Attitude and Practices
MOE	Ministry of Education
MOH	Ministry of Health
PLS-SEM	Partial Lease Squares Structural Equation Modelling
RTE	Ready-to-eat
SEM	Structural Equation Modelling
SK	Sekolah Kebangsaan
SKJC	Sekolah Kebangsaan Jenis Cina
SKJT	Sekolah Kebangsaan Jenis Tamil
SMK	Sekolah Menengah Kebangsaan
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
VIF	Variance Inflation Factor

LIST OF GLOSSARIES

Canteen	a place where food and drinks are sold, often at a lower price
Focus group	A well-planned series of discussions designed to identify perceptions on a defined topic of interest
Food handler	a person who is involved in food preparation and comes into contact with food, food contact surfaces, packaged or unpackaged food in food premises
Foodborne illness	disease that are infectious or toxic in nature and caused by bacteria, viruses, parasites or chemicals entering the body through contaminated food or water
Food contamination	Food that has been corrupted with another substance (biological, chemical or physical)
Food poisoning	illness caused by eating food or drinks that contain toxins that are released by dangerous pathogens
Food safety	assurance that foods served are chemically, physically and microbiologically safe for ingestion
Foodservice industry	the serviced provision of meals purchased outside home
Needs assessment	a process determining, analyzing, and prioritizing needs and identifying strategies to address them
Personal hygiene	includes the attire, hand hygiene, and the personal health and behaviour of food handlers during food handling
Ready-to-eat food	Products that are safe to eat without additional preparation
Temperature abuse	Insufficient cooking and keeping food at ambient temperature for extended period of time which give rise to the growth of microorganisms in food

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter describes the background of study by giving an overview of food safety issues and its implications in school foodservice operations. It also highlights how poor food handling behavior among food handlers contribute to foodborne outbreaks and why educational interventions should target behavior-change. The chapter also includes the problem statement, significance of study and research objectives. This study employed a mixture of qualitative and quantitative method to achieve the objectives, namely focus group discussions, survey questionnaire and direct observation method. Thesis organization is also presented at the end of this chapter.

1.2 Background of Study

Foodborne illness is a global health concern and is threatening the lives of millions worldwide. The illness, commonly associated with the consumption of contaminated food or water, pose a threat to unsuspecting consumers at foodservice establishments. An estimated of one in every 10 people globally would be affected in some sort of foodborne illness every year. Till date, up to 420,000 deaths due to the ingestion of unsafe food have been reported. Even though unsafe food causes health risks to everyone, vulnerable groups such as children, pregnant women, elderly, and the immunocompromised may have more severe consequences (World Health Organization, 2019c).

Being a tropical country, Malaysia is not spared from the foodborne illness burden. The hot and humid climate in Malaysia is especially conducive for the growth of microorganisms in food (Abdul-Mutalib et al., 2015). Despite the fluctuation in the number of foodborne cases in Malaysia over the years, there are persistent outbreaks that warrant for attention. The number of food poisoning cases increased by 9.21%, from a total of 13,490 cases in 2017 to 14,732 cases in the same period of 2018 (Ministry of Health Malaysia, 2018a). One such case was attributable to the bacteria, *Salmonella enterica* serovar weltevreden. According to New Straits Times (2018), the Salmonella poisoning caused 83 cases and two deaths due to the consumption of *laksa* noodles in three states in Malaysia. Among the cited reasons were poor hygiene, improper storage, and inadequate cooking and reheating of the food.

Majority of the food poisoning cases in Malaysia occurred in schools (New et al., 2017). From year to year, an increasing trend of food poisoning cases were observed. From the year 2010 to 2015, the number of cases occurring in schools increased from 3822 to

8000 cases (Fuentes, 2015). In addition, foodborne outbreaks in schools increased by a drastic 57% within the first four months of 2016, with 95.7% of these cases occurring in school or hostel kitchens (The Sun Daily, 2016). As students, also regarded as 'captive customers', rely heavily on foods sold in schools, improperly cooked food will put them at risk of contracting foodborne illness (Aziz & Dahan, 2013). Young children are at a higher risk of contracting foodborne illness as they do not have fully mature immune system (Barrett & Riggins, 2011). In addition to affecting the health of the young population, food safety is also an economic burden to the country (New et al., 2017). Thus, various measures need to be taken to improve food safety in schools.

Literature have shown that food handlers are generally accountable for foodborne outbreaks through various means (Chapman et al., 2010; Sharif et al., 2013), and up to 97% of cases associated with food handlers have been reported (Egan et al., 2007). Among many, food handlers' health status and their respective food safety behaviors have great impact on food contamination risks (Bhausaheb et al., 2010). According to the US FDA (2018), the three critical risk factors requiring improvement that are directly related to food handlers' behaviour are: (1) improper holding, (2) protection from contamination, and (3) poor personal hygiene. Harmful microorganisms associated with poor personal hygiene have the highest incidence and it was recommended that food safety education should focus on handwashing, adequate cooking, and avoiding cross-contamination (Medeiros et al., 2001).

Improper handwashing practices, a subset of personal hygiene, has been identified as one of the main contributing factor to foodborne illness (Green et al., 2006; Robertson et al., 2013). Despite being generally knowledgeable about hand hygiene, majority of the food handlers do not carry out proper handwashing at work (Pellegrino et al., 2015). The adherence to hand hygiene in foodservice remains low, with studies recording 0% (Tan, Bakar, Abdul Karim, et al., 2013), 19% (US FDA, 2000), 31% (Clayton & Griffith, 2004), and 27% (Green et al., 2006) compliance. As the food handlers' hands harbor infinite amount of microorganisms, poor hand hygiene will contribute to the spread of diseases (Gashaw et al., 2008). Performing proper handwashing could lead to at least a 2 log reduction in bacteria, viruses and protozoa (US FDA, 2013) and significantly reduce the risk of foodborne illness (Yu et al., 2018).

Cross contamination, the potential contamination of a ready-to-eat (RTE) food through direct or indirect contact with a contaminant, is another important factor that influence food safety (Chapman et al., 2013). For instance, harmful microorganisms can be transmitted from raw food (Baş et al., 2006), bare hands or contaminated gloves (Robertson et al., 2013) to a RTE food. Cross contaminations caused by food handlers were sighted in school foodservice operations in Korea (Ryu et al., 2011), and grocery store food handlers in the US (Robertson et al., 2013). Nevertheless, there is generally lack of published reports specifically on food handlers' cross contamination behavior. Thus, the potential for cross contamination to happen is much greater than foodborne outbreak data suggest (Clayton & Griffith, 2004).

Temperature abuse has been identified as another important contributory factors for foodborne outbreaks (Smigic et al., 2016; Tóth et al., 2017) and this risk factor is also apparent in Malaysia (Abdul-Mutalib et al., 2015; Musa et al., 2015; Sharifa et al., 2013). This includes insufficient cooking and keeping food at ambient temperature for extended period of time which give rise to the growth of microorganisms in food (Abdul-Mutalib et al., 2015). In order to ensure food doneness, the use of food thermometers is highly recommended. However, based on a review of 85 studies done for the past two decades, it was highlighted that the compliance to thermometer-use was still low (Feng & Bruhn, 2019). The lack of compliance may lead to the growth of dangerous pathogens in food. These critical risk factors generally stemmed from food handlers and is preventable through appropriate food safety education (Mcfarland et al., 2019).

Training of food handlers is an important strategy for managing food safety (Nieto-Montenegro et al., 2008). Most formal certificated food hygiene training programmes is designed using the Knowledge, Attitude, and Practices (KAP) model, that emphasizes greatly on the provision of knowledge (Tan, Bakar, Abdul Karim, et al., 2013). Similarly, majority of the food safety studies done in Malaysia revolve around the KAP model (Abdul-Mutalib et al., 2012; Abdullah Sani & Siow, 2014; Norazmir et al., 2012; Siau, 2015). Even though positive increase in knowledge have been reported following training intervention (McIntyre et al., 2013; Soon & Baines, 2012), improvement in attitude and actual food handling practices may not occur (Da Cunha et al., 2014; Mullan & Wong, 2010; Park et al., 2010). In a review study involving 253 articles and 36 original articles on the food safety KAP of food handlers, it was concluded that 50% of the studies reported a lack of translation of knowledge into attitude and practices following training (Zanin et al., 2017). This situation is obvious especially when food handlers had to multitask during meal peak hours (Yu et al., 2018).

As educational intervention that only concentrates on knowledge-provision is not sufficient to change behaviour (Yu et al., 2018), this raise the need for multiple-component intervention that involves a combination of training and other behavioral change strategies, such as providing feedback, reminders, resources, incentives or involvement of superior (Doronina et al., 2017). Intervention programmes targeting behavioural change was found to be more effective in improving handwashing behaviour (Yu et al., 2018). In an intervention study by York, Brannon, Shanklin, Roberts, Howells, et al. (2009) using the Theory of Planned Behavor (TPB) as a framework, it was reported that training generally improved handwashing knowledge, but when combined with a mixture of incentives, persuasive messages and provision of thermometer, the overall behavioral compliance improved significantly. The effectiveness of food hygiene education could be greatly improved through the use of health education theories and models. Food safety education should incorporate elements of behavioural change theories, motivational, and other environmental factors to improve the training effectiveness of food handlers (Medeiros et al., 2001).

Many models have been used to understand the behaviour of food handlers. Among many, are the TPB and the Health Belief Model (HBM). As with many social cognitive models, there are a number of criticisms on TPB and HBM. TPB emphasizes that attitude act as a predictor of behavioural intention, but Naidoo and Wills (2000)

argued that behavior may not necessarily be predicted by attitudes. While the HBM is mainly guided by beliefs, values and perception, it overemphasizes a rational approach to behaviour and excludes the influential effects of social norms (Corcoran, 2010). Although HBM has been widely used in health prevention programmes, it cannot fully explain the complexity behaviour of food handlers when it comes to food safety practices (McArthur et al., 2006). When HBM was used to predict food safety behaviour, it was found to be lacking in predictive power. Studies on food hygiene ought to also include other dimensions, such as knowledge, norms and environmental condition to better explain food safety behavioural intention and behaviour.

One model that helps to improve understanding of the social, psychological, and environmental factors that influence a person's decision-making behaviour and subsequent behaviours is the Health Action Model (HAM) (Nieto-Montenegro et al., 2006; Tones & Tilford, 1994). This model has been applied in food hygiene education and it provides a comprehensive coverage of factors influencing behavioural change following training. Although not widely tested, HAM had been successfully used to promote general safe behaviour among workers in a steel company in Iran (Mazaheri & Heidarnia, 2015), develop a food hygiene training course for butchers (Vaz et al., 2005), and in the designing of food safety education programme for Hispanic workers in the mushroom industry (Nieto-Montenegro et al., 2006, 2008). Therefore, this study set out to conduct a needs assessment using an extended-HAM model and to develop and assess the effectiveness of a customized intervention programme in improving food safety behaviors among school food handlers.

1.3 Problem Statement

The persistent occurrence of foodborne illnesses may lead to severe economic losses and put the lives of many at risk. In Malaysia, majority of the food poisoning cases happened in schools and is still on the rise (New et al., 2017; New Straits Times, 2019). From the year 2010 to 2015, an obvious increase in the number of cases in schools was observed, from 3822 to 8000 cases, in a span of 5 years (Figure 1.1) (Fuentes, 2015). A staggering 57% increase in the first four months of 2016 was reported, with 95.7% of these cases occurring in schools (The Sun Daily, 2016). In the year 2018, a 24% increase of cases was recorded compared to the previous year (New Straits Times, 2019). Children in particular are at an increased risk of contracting foodborne illness as they have immature immune system (Barrett & Riggins, 2011). As students rely heavily on foods sold in schools, improperly cooked food will put them at risk (Aziz & Dahan, 2013). Literature have shown that most outbreaks are associated with food handlers' food safety behavior (Sharif et al., 2013), and are thus preventable. Unfortunately, the food handlers in Malaysia still exhibited poor compliance to various food safey practices (Abdul-Mutalib et al., 2015; Musa et al., 2015; Sharifa Ezat et al., 2013).

In order to improve food safety, besides through formal trainings (Soon et al., 2011), it is crucial to alter people's behavior (Yiannas, 2009). Training that only focus on knowledge provision based on the KAP model is not sufficient to change behaviour (Yu et al., 2018). The use of multiple-component intervention, involving a combination

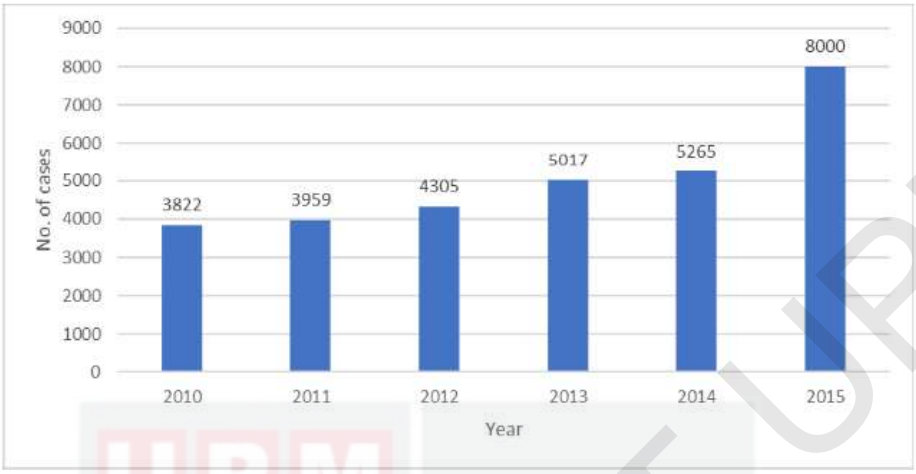

Figure 1.1: Food Poisoning Cases occuring in Schools in Malaysia from 2010 to 2015 (adopted from Fuentes, 2015)

of training and other strategies may be more effective (Doronina et al., 2017). Published literature on interventions, while useful, may not be applicable in all populations due to the differences in social, cultural and economic context (Foster & Kaferstein, 1985). Before developing any intervention, it is crucial to identify the food handling beliefs and behaviors, and have specifically designed messages for the target audience (Medeiros et al., 2001). As there is a lack of educational intervention been specifically designed for Malaysian school foodservice, it creates a gap that needs to be addressed.

In Malayia, there are lack of studies that use social cognition model to change food handlers' behavior. Majority of the food safety studies have focused on investigating the KAP of food handlers (Abdul-Mutalib et al., 2012; Abdullah Sani & Siow, 2014; Lee et al., 2017; Norazmir et al., 2012; Siau et al., 2015; Siow & Abdullah Sani, 2011; Tan, Bakar, Abdul Karim, et al., 2013), which are commonly criticized for the knowledge-behavioural compliance gap. Till date, only two such studies exist, which utilized the Theory of Planned Behavior (TPB) to predict intention (Ahmad et al., 2018) and to develop an educational intervention to improve handwashing practices (Nil Rosmawati et al., 2018). Ahmad et al. (2018) found that perceived behavior control and attitude fail to predict intention. On the other hand, Nik Rosmawati et al. (2018) reported that there was no significant difference between the mean proportion in handwashing practices of trained and control group. Due to the inconclusive results of the two studies and the limitation of KAP model, HAM was used as a framework for needs assessment in this study. This is the first study that uses HAM model in school foodservice operations.

HAM, recommended for use in food hygiene education (Rennie, 1995), is able to address some of the limitations of KAP model as it helps to improve understanding of the social, psychological, and environmental factors that influence a person's intention

and subsequent behaviours (Nieto-Montenegro et al., 2006). Till date, HAM had been mainly used as a framework to develop a food safety training course for butchers (Vaz et al., 2005), and educational material for Hispanic workers in the mushroom industry (Nieto-Montenegro et al., 2006). Even though both studies showed promising results, no empirical study on the model has been done. In addition, the belief and motivation consructs under HAM have underlying dimensions (Arendt et al., 2011; Barrett & Riggins, 2011; Harris et al., 2017) which have not been thoroughly investigated. Therefore, there is a need to empirically test an extended-HAM by incorporating the dimensions of beliefs and motivation. This study is expected to identify significant factors that improve selected food safety behaviors as the underlying basis for the development of a strategic intervention. As the type of intervention varies according to the nature of foodservice operations, the needs assessment enables the design of a customized intervention to improve food safety in schools.

1.4 Objectives of the Study

This study aimed to conduct a needs assessment and to develop and assess the effectiveness of a customized intervention programme in improving food safety behaviors among school food handlers. The specific objectives are:

1) To gain an insight on the current practices, perceived barriers and motivators to perform three selected food safety behaviors (handwashing, contamination prevention and temperature control) among school food handlers.
2) To conduct a needs assessment and to identify priority variable that can be enhanced to improve handwashing and contamination prevention behavior.
3) To evaluate the effectiveness of a food safety intervention by comparing the handwashing and contamination prevention knowledge, self-efficacy and behavioral compliance score between control and treatment group.

1.5 Overview of the Conceptual Framework

The mixed-method study consists of two research phase. It began with a qualitative phase that is made up of a series of focus group discussions to identify the current practices, perceived barriers and motivators of food handlers to perform the selected food safety behavior. This was followed by a quantitative phase, where HAM was used as the underlying theoretical framework of the study (Figure 1.2). According to HAM, the intention to perform an action is influenced by a set of beliefs, motivations, and norms, all of which establish a state of preparedness for action when there are supportive conditions. Social pressures or norm influences both the motivation and the belief of an individual. In turn, motivation influences both belief and the intention to perform a particular behaviour. Intention can be translated into actual behaviour provided if appropriate environmental conditions are available. Habit is also said to influence behaviour directly as individuals may also make a decision without considering various options or analysis of the situation (Tones & Tilford, 1994). Full details of HAM and the hypothesis testing for the model are described in literature review and Chapter 4, respectively.

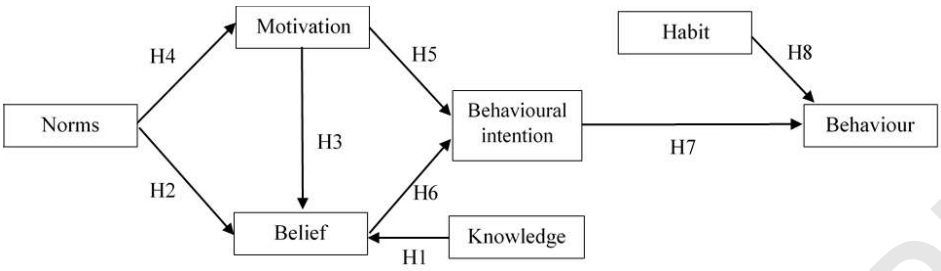

Figure 1.2: Conceptual Framework based on Health Action Model (HAM)
Note: Endogenous latent variable: Behavioral intention, behavior
Exogenous latent variable: Knowledge, belief, norms, motivation, habit

1.6 Overview of Methodology

A mixed-method approach, a combination of qualitative and quantitative method was used to achieve the research objectives. In a mixed-method study, the integration of both qualitative and quantitative methods is far superior than the conventional mono-method research as it provides a through understanding of the research problem (Johnson & Onwuegbuzie, 2004). The study first conducted focus group discussions to identify the current practices, perceived barriers and motivators of school food handlers in carrying out selected food safety behaviors. The qualitative findings, together with insight from previous literature, content validation and pre-test results were used as part of the instrument adaptation and validation process. This was followed by needs assessment of school foodservice operations and the intervention phase, using a combination of survey and direct observation method. The overall flow of study is shown in Figure 1.3.

1.7 Significance of the Study

Theoretical research has often been criticized of the lack of grasps of the broader view, especially in terms of translating research into practical suggestions that will have impact on people in the real world (Michie et al., 2007; Moss-Morris & Yardley, 2008). To bridge the gap between theory and practice, this study has both theoretical and practical significance, and are able to contribute to the academics, policymakers and school foodservice managers, as discussed below:

1.7.1 Theoretical significance

Following the early efforts to applying the HAM model as a framework in designing food safety educational materials (Nieto et al., 2006; Vaz et al., 2005), this study is expected to have theoretical significance by being the first to empirically study the

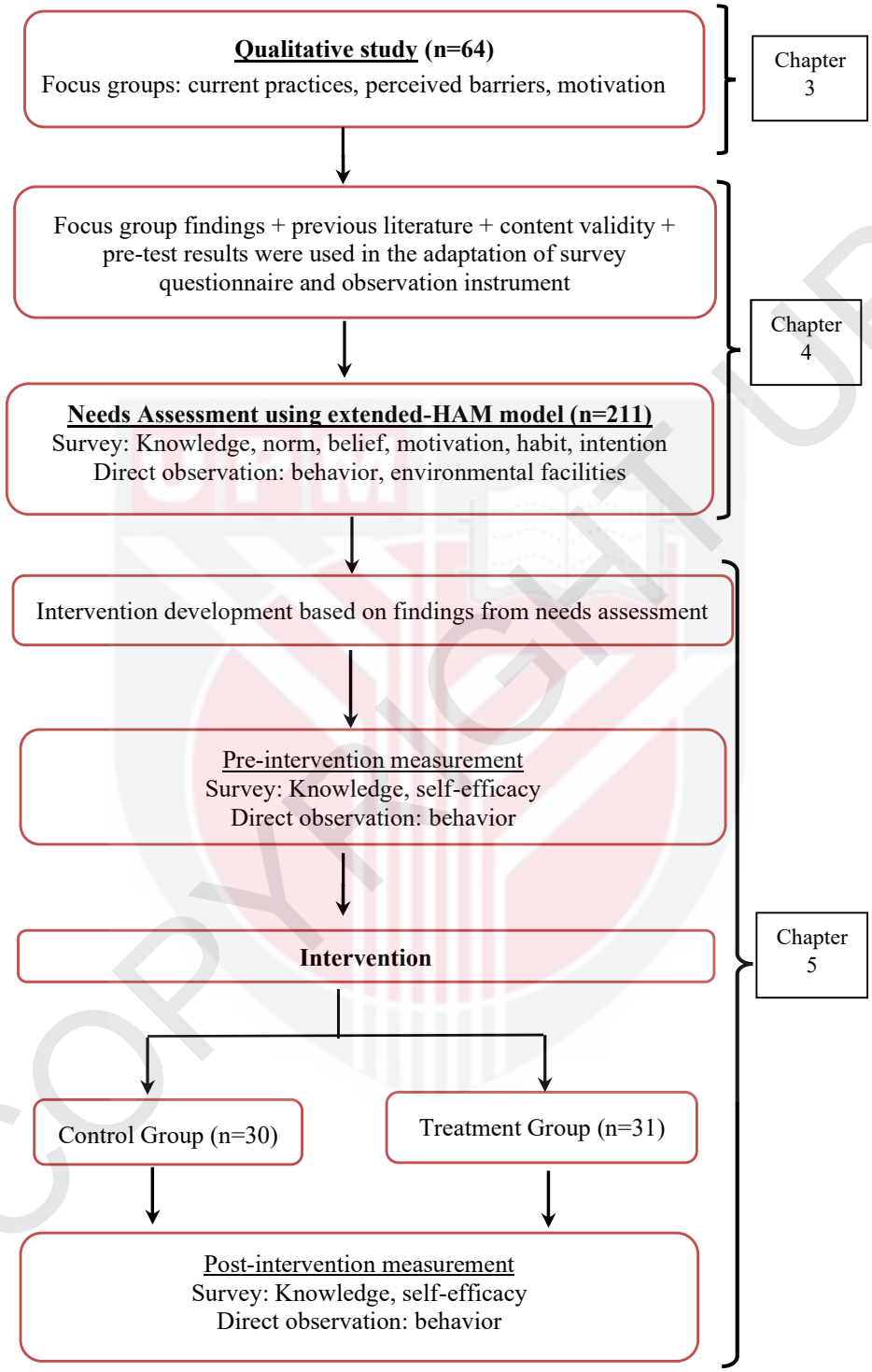

Figure 1.3: Overall Flow of Study

HAM model using actual observed food safety behavioural data. By moving beyond self-report measure of behaviour, which has been long known for its limitations, incorporating observed behavioural data in the model paints a more realistic picture of the actual behaviour of food handlers. In addition, the belief and motivation consructs have underlying dimensions and such studies applied to foodservice setting have been limited (Arendt et al., 2011; Barrett & Riggins, 2011; Harris et al., 2017). By incorporating the dimensions in the extended-HAM model, this study is expected to provide useful information on the five dimensions of beliefs and four dimensions of motivation, from the perspective of Malaysian school foodservice.

1.7.2 Practical significance

Published literature on interventions, while useful, may not be applicable in all populations and situation due to the differences in social, cultural and economic context (Foster & Kaferstein, 1985). As there is a lack of educational intervention been specifically designed for Malaysian school foodservice, it creates a gap that needs to be addressed. Using a mixed method approach (focus group, direct observation and survey). this study provides realistic insights on the actual scenario of school foodservice operations in Malaysia and sheds some light on the factors that influence selected food safety behavior. From the perspective of policymakers and school foodservice managers, this study provides valuable information regarding factors that should be prioritised for future intervention programs targeting selected food safety behaviour among school food handlers. Improving food safety behaviour of food handlers has direct impact in ensuring food safety in schools. Some of the findings may also be used to enhance existing food safety initiatives and policies concerning school foodservice operations in Malaysia.

1.8 Thesis Organization

Overall, this thesis is made up of six chapters (Figure 1.4), which is organized as follows:

Chapter One describes the background of study and gives an overview why the study is important. The chapter also includes the problem statement and objectives of the study.

Chapter Two provides a review on related literature, covering an overview of the foodservice industry and the current food safety scenario at a global and national level. The chapter also highlights the main risk factors of foodborne illness and explains how most cases stem from poor food handling behavior of food handlers. Besides, it also provides a review on past intervention studies done and some of the theories and models used in food safety studies.

Chapter Three narrates the qualitative findings through focus group discussions, with respect to objective 1 of the study. The chapter is important as it sheds some light on school food handlers' current practices, perceived barriers and motivation to perform selected food safety behavior. Some of the information gathered were used as part of the instrument adaptation and validation process in Chapter 4, to quantitatively measure the perceived barriers and motivation of the study population. The use of this qualitative study is expected to help in assuring the content validity of the instrument used in a Malaysian context. In addition, it also provides a realistic picture of the current situation at school foodservice operations which helps in the development of an intervention in Chapter 5.

Chapter Four represents the food safety needs assessment phase, with respect to the objectives 2 of the study. The chapter highlights the use of an extended Health Action Model (HAM) to identify variables that influence behavioral intention and behavior. Results from Importance and Performance Matrix Analysis (IPMA) identified a priority variable that can be enhanced to improve behaviour. Findings from this chapter were used to develop an intervention programme to improve food safety behavior in Chapter 5.

Chapter Five presents the results of the intervention phase, with respect to objective 3 of this study. The effectiveness of a food safety intervention programme in terms of the knowledge, self-efficacy and behavioral compliance score were discussed.

Chapter Six is the conclusion chapter which summarizes the major findings of this study. This chapter also discuss the limitations of study and suggestions for future research.

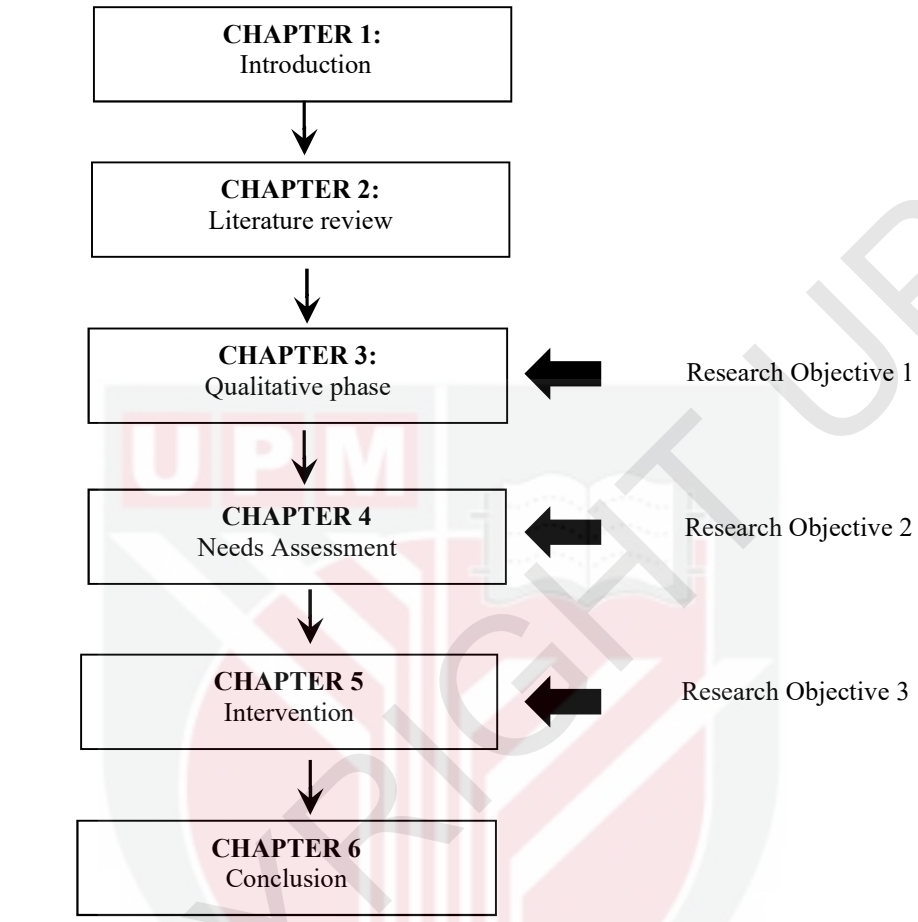

Figure 1.4: Thesis Structure

REFERENCES

Abbot, J. M., Byrd-Bredbenner, C., Schaffner, D., Bruhn, C. M., & Blalock, L. (2009). Comparison of food safety cognitions and self-reported food-handling behaviors with observed food safety behaviors of young adults. *European Journal of Clinical Nutrition*, *63*(4), 572–579. https://doi.org/10.1038/sj.ejcn.1602961

Abdul-Mutalib, N. A., Syafinaz, A. N., Sakai, K., & Shirai, Y. (2015). An overview of foodborne illness and food safety in Malaysia. *International Food Research Journal*, *22*(3), 896–901.

Abdul-Mutalib, N. A., Abdul-Rashid, M-. F., Mustafa, S., Amin-Nordin, S., Hamat, R. A., & Osman, M. (2012). Knowledge, attitude and practices regarding food hygiene and sanitation of food handlers in Kuala Pilah, Malaysia. *Food Control*, *27*(2), 289–293. https://doi.org/10.1016/j.foodcont.2012.04.001

Abdullah Sani, N., & Siow, O. N. (2014). Knowledge, attitudes and practices of food handlers on food safety in food service operations at the Universiti Kebangsaan Malaysia. *Food Control*, *37*(1), 210–217. https://doi.org/10.1016/j.foodcont.2013.09.036

Adams, M.R., Moss, M.O., & McClure, P. (2018). Food Microbiology (4th ed.). UK: The Royal Society of Chemimstry.

Afolaranmi, T.O., Hassan, Z.I., Bello D.A., Tagurum, Y.O., Miner, C.A., Zoakah, A.I., & Ogbonna, C. (2014). Training: A vital tool for improving the knowledge and practice of food safety and hygiene among food handlers in boarding secondary schools in Plateau State. *Journal of Medicine in the Tropics, 16*, 87-92.

Ahmad, I. A., Fatimah, U., Zainal, U., Mahyudin, N. A., Khaizura, N., & Ab, M. (2018). A structural analysis of behavioral determinants affecting food handlers ' proper handwashing practices in school canteen. *International Journal of Academic Research in Business nad Social Sciences, 8*(17), 324–339. https://doi.org/10.6007/IJARBSS/v8-i17/5236

Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology & Health, 26*(9), 1113–1127.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50,* 179–211. http://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice-Hall.

Allison, M. J., & Keller, C. (2004). Self-efficacy intervention effect on physical activity in older adults. *Western Journal of Nursing Research*, *26*(1), 31–46. https://doi.org/10.1177/0193945903259350

Amegah, K. E., Addo, H. O., Ashinyo, M. E., Fiagbe, L., Akpanya, S., Akoriyea, S. K., & Dubik, S. D. (2020). Determinants of hand hygiene practice at critical times among food handlers in educational institutions of the Sagnarigu Municipality of Ghana: A cross-sectional study. *Environmental Health Insights*, *14*, 1–10.

Anderson, M. E. C., Sargeant, J. M., & Weese, J. S. (2014). Video observation of hand hygiene practices during routine companion animal appointments and the effect of a poster intervention on hand hygiene compliance. *BMC Veterinary Research*, *10*, 106. https://doi.org/10.1186/1746-6148-10-106

Arendt, S., Strohbehn, C., & Jun, J. (2015). Motivators and barriers to safe food practices: Observation and interview. *Food Protection Trends, 35*(5), 365-376.

Arendt, S. W., Ellis, J. D., Strohbehn, C., & Paez, P. (2011). Development and use of an instrument to measure retail foodservice employees' motivation for following food safety practices. *Journal of Foodservice Business Research*, *14*(1), 68–85. https://doi.org/10.1080/15378020.2011.548227

Arendt, S. W., Roberts, K. R., Strohbehn, C., Arroyo, P. P., Ellis, J., & Meyer, J. (2014). Motivating foodservice employees to follow safe food handling practices: perspectives from a multigenerational workforce. *Journal of Human Resources in Hospitality and Tourism*, *13*(4), 323–349. https://doi.org/10.1080/15332845.2014.888505

Astro Awani. (2014). Kanak-kanak 5 tahun maut akibat keracunan makanan. https://www.youtube.com/watch?v=9SLrLYlg47g

Aziz, S. A. A., & Dahan, H. M. (2013). Food handlers' attitude towards safe food handling in school canteens. *Procedia - Social and Behavioral Sciences*, *105*, 220–228. https://doi.org/10.1016/j.sbspro.2013.11.023

Babbie, E. (2012). The basics of social research (6th ed.). Canada: Wadsworth Publishing Co Inc.

Bai, L., Tang, J., Yang, Y., & Gong, S. (2014). Hygienic food handling intention. An application of the Theory of Planned Behavior in the Chinese cultural context. *Food Control, 42,* 172-180.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behaviour Research and Therapy*, *1*, 139–161. https://doi.org/10.1017/S0003055400259303

Barrett, B,. & Riggins, L. (2011). Beliefs and perceptions of school foodservice personnel about following a HACCP- based program. *Food Protection Trends*, *31*(10), 612–619.

Baş, M., Şafak Ersun, A., & Kivanç, G. (2006). The evaluation of food hygiene knowledge, attitudes, and practices of food handlers' in food businesses in Turkey. *Food Control*, *17*(4), 317–322. https://doi.org/10.1016/j.foodcont.2004.11.006

Baser, F., Ture, H., Abubakirova, A., Sanlier, N., & Cil, B. (2016). Structural modeling of the relationship among food safety knowledge, attitude and behavior of hotel staff in Turkey. *Food Control, 73(B),*438-444. https://doi:10.1016/j.foodcont.2016.08.032

Behnke, C., & Seo, S. (2015). Using smartphone technology to assess the food safety practices of farmers' market foodservice employees. *Journal of Foodservice Business Research*, *18*(1), 1–19. https://doi.org/10.1080/15378020.2015.995748

Berglund, E., Lytsy, P., & Westerling, R. (2013). Adherence to and beliefs in lipid-lowering medical treatments: A structural equation modeling approach including the necessity-concern framework. *Patient Education and Counseling*, *91*(1), 105–112. https://doi.org/10.1016/j.pec.2012.11.001

Bergsma, N.J., Fisher, A.R.H., van Asselt, E.D., Zwietering, M.H., & de Jong, A.E.I. (2007). Consumer food preparation and its implication for survival of *Campylobacter jejuni* on chicken. *British Food Journal*, 109(7), 548-561.

Bermudez-Aguirre, D., & Corradini, M.G. (2012). Inactivation kinetics of Salmonella spp. under thermal and emerging treatments: A review. *Food Research International*, 45(2), 700-712.

Bhausaheb, A., Associate, M., Kesharwani, N., Mudey, G. A., Goyal, R. C., Dawale, A. K., & Wagh, V. V. (2010). Health status and personal hygiene among food handlers working at food establishment around a rural teaching hospital in Wardha district of Maharashtra, India. *Global Journal of Health Science*, *2*(2), 198–206.

Boyce, J. M. (2019). Current issues in hand hygiene. *American Journal of Infection Control. 47*, A46 -A52. *https://doi.org/10.1016/j.ajic.2019.03.024*

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. http://doi.org/10.1191/1478088706qp063oa

Campbell, J. L., Quincy, C., Osserman, J., & Pedersen, O. K. (2013). Coding in-depth semistructured interviews: Problems of unitization and intercoder reliability and agreement. *Sociological Methods and Research*, *42*(3), 294–320. https://doi.org/10.1177/0049124113500475

Chapman, B., Eversley, T., Fillion, K., Maclaurin, T., & Powell, D. (2010). Assessment of food safety practices of food service food handlers (risk assessment data): Testing a communication intervention (evaluation of tools). *Journal of Food Protection*, *73(6)*, 1101–1107.

Chapman, B. J., Maclaurin, T., & Powell, D. a. (2013). Video observation and data goding methods to assess food handling practices at food service. *Food Protection Trends*, *33*(3), 146–156.

Chaves, A. F. L., Ximenes, L. B., Rodrigues, D. P., Vasconcelos, C. T. M., Monteiro, J. C. dos S., & Oriá, M. O. B. (2019). Telephone intervention in the promotion of self-efficacy, duration and exclusivity of breastfeeding: Randomized controlled trial. *Revista Latino-Americana de Enfermagem*, *27*, 3140. https://doi.org/10.1590/1518-8345.2777-3140

Chin, W. W. (1998). Issues and opinion on structural equation modeling. *MIS Quarterly: Management Information Systems, 22*(1), vii-xvi.

Cho, S., Hertzman, J., Erdem, M., & Garriott, P. O. (2013). A Food Safety Belief Model for Latino (A) employees in foodservice. *Journal of Hospitality & Tourism Research*, *37*(3), 330–348. https://doi.org/10.1177/1096348012436378

Cho, S., Hertzman, J., Erdem, M., & Garriott, P. (2010). Changing Food Safety

Behavior Among Latino(a) Food Service Employees: The Food Safety Belief Model. *International CHRIE Conference-Refereed Track, 22*, 0–11. http://scholarworks.umass.edu/refereed/CHRIE_2010/Friday/22

Choudhury, M., Mahanta, L. B., Goswami, J. S., & Mazumder, M. D. (2011). Will capacity building training interventions given to street food vendors give us safer food?: A cross-sectional study from India. *Food Control*, *22*(8), 1233–1239. https://doi.org/10.1016/j.foodcont.2011.01.023

Chow, S., & Mullan, B. (2010). Predicting food hygiene. An investigation of social factors and past behaviour in an extended model of the Health Action Process Approach. *Appetite*, *54*(1), 126–133. https://doi.org/10.1016/j.appet.2009.09.018

Cicchetti, D.V. (2015). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instrument in psychology. *Psychological Assessment*, *6*(4), 284-290. https:// doi.org/10.1037/1040-3590.6.4.284

Clark, J., Crandall, P., & Reynolds, J. (2019). Exploring the influence of food safety climate indicators on handwashing practices of restaurant food handlers. *International Journal of Hospitality Management, 77,* 187-194. https://doi.org/10.1016/j.ijhm.2018.06.029

Clayton, D. a., & Griffith, C. J. (2004). Observation of food safety practices in catering using notational analysis. *British Food Journal*, *106*(3), 211–227. https://doi.org/10.1108/00070700410528790

Clayton, M. L., Smith, K. C., Neff, R. A., Pollack, K. M., & Ensminger, M. (2015). Listening to food workers: Factors that impact proper health and hygiene practice in food service. *International Journal of Occupational and Environmental Health*, *21*(4), 314–327. https://doi.org/10.1179/2049396715Y.0000000011

Cohen, J. (1988). Statistical power analysis for the behavioural science (2nd ed.). New York: Lawrence Erlbaum Associates.

Conklin, M. T., Lambert, L. G., & Anderson, J. B. (2002). How long does it take students to eat lunch? Summary of three studies. *Journal of Child Nutrition and Management*, *26*(2), 1–9.

Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research, and Evaluation, 10(7)*, 1-9. https://doi.org/10.7275/jyj1-4868

Cooper, D. R., & Schindler, P. S. (2013). Business research methods (12th ed.). New York, USA: McGraw-Hill.

Corcoran, N. (2010). Communicating health: strategies for health promotion. London, UK: Sage Publications Ltd.

Creswell, J.W., & Clark, V.L.P. (2007). Designing and conducting mixed methods research. USA: SAGE Publications.

Cruz, M. A., Katz, D. J., & Suarez, J. A. (2001). An assessment of the ability of routine restaurant inspections to predict food-borne outbreaks in Miami-Dade County, Florida. *American Journal of Public Health*, *91*(5), 821–823.

https://doi.org/10.2105/AJPH.91.5.821

da Cunha, D. T., Fiorotti, R. M., Baldasso, J. G., de Sousa, M., Fontanezi, N. M., Caivano, S., Stedefeldt, E., de Rosso, V.V., & Camargo, M. C. R. (2013). Improvement of food safety in school meal service during a long-term intervention period: a strategy based on the knowledge, attitude andpractice triad. *Food Control*, *34*(2), 662–667. https://doi.org/10.1016/j.foodcont.2013.06.003

da Cunha, D. T., Stedefeldt, E., & de Rosso, V. V. (2014). The role of theoretical food safety training on Brazilian food handlers' knowledge, attitude and practice. *Food Control*, *43*, 167–174. https://doi.org/10.1016/j.foodcont.2014.03.012

Davis, L. L. (1992). Instrument review: Getting the most from a panel of experts. *Applied Nursing Research*, *5*(4), 194–197.

de Jong, A. E. I., van Asselt, E. D., Zwietering, M. H., Nauta, M. J., & de Jonge, R. (2012). Extreme heat resistance of food borne pathogens *Campylobacter jejuni*, *Escherichia coli*, and *Salmonella typhimurium* on chicken breast fillet during cooking. *International Journal of Microbiology*, 1–10. https://doi.org/10.1155/2012/196841

de Jong, M. G., Pieters, R., & Fox, J. P. (2010). Reducing social desirability bias through item randomized response: An application to measure underreported desires. *Journal of Marketing Research*, *47*(1), 14–27. https://doi.org/10.1509/jmkr.47.1.14

Doronina, O. R. N., Jones, D., Martello, M., Biron, A., & Lavoie-Tremblay, M. (2017). A systematic review on the effectiveness of interventions to improve hand hygiene compliance of nurses in the hospital setting. *Journal of Nursing Scholarship*, *49*(2), 143–152. https://doi.org/10.1111/jnu.12274

do Prado, D. B., Bettoni, A. P., Correa, V. A., de Abreu Filho, B. A., Garcia, L. B., Tognim, M. C. B., & Cardoso, C. L. (2015). Practice of hand hygiene in a university dining facility. *Food Control*, *57*, 35–40. https://doi.org/10.1016/j.foodcont.2015.03.024

Ebrahim AlZaabi, S., & Ali Khan, M. (2017). A study on foodborne bacterial cross-contamination during fresh chicken preparation. *Arab Journal of Nutrition and Exercise (AJNE)*, *2*(2), 128-138. https://doi.org/10.18502/ajne.v2i2.1251

Edwards, J. S. A. (2013). The foodservice industry: Eating out is more than just a meal. *Food Quality and Preference*, *27*(2), 223–229. https://doi.org/10.1016/j.foodqual.2012.02.003

Edwards, J. S. A., & Overstreet, K. (2009). What is foodservice? *Journal of Foodservice*, *20*, 1–3.

Egan, M., Raats, M., Grubb, S., Eves, a, Lumbers, M., Dean, M., & Adams, M. (2007). A review of food safety and food hygiene training studies in the commercial sector. *Food Control*, *18*(10), 1180–1190. https://doi.org/10.1016/j.foodcont.2006.08.001

Ehiri, J. E., Morris, G. P., & McEwen, J. (1997). Evaluation of a food hygiene training course in Scotland. *Food Control*, *8*(3), 137–147. https://doi.org/10.1016/S0956-

7135(97)00005-4

Ellis, J. D., Arendt, S. W., Strohbehn, C. H., Meyer, J., & Paez, P. (2010). Varying influences of motivation factors on employees' likelihood to perform safe food handling practices because of demographic differences. *Journal of Food Protection*, *73*(11), 2065–2071.

Faour-Klingbeil, D., Kuri, V., & Todd, E. (2015). Investigating a link of two different types of food business management to the food safety knowledge, attitudes and practices of food handlers in Beirut, Lebanon. *Food Control*, *55*, 166–175. https://doi.org/10.1016/j.foodcont.2015.02.045

Feng, Y., & Bruhn, C. M. (2019). Motivators and barriers to cooking and refrigerator thermometer use among consumers and food workers: A review. *Journal of Food Protection, 82*(1), 128–150. https://doi.org/10.4315/0362-028X.JFP-18-245

Flamer, A. (2015). Self-Efficacy. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioural Sciences* (2nd Ed.) (pp. 504-508). USA: Elsevier Ltd.

Food Act 1983 [ACT 281] & Regulations (2013). Food Hygiene Regulations 2009. Kuala Lumpur: International Law Book Services.

Food Safety Information Council (2019). Cross contamination. Retrieved March 28, 2020, from https://www.foodsafety.com.au/blog/food-safety-and-the-different-types-of-food-contamination

Foster, G. M., & Käferstein, F. K. (1985). *Food safety and the behavioural sciences. Social Science & Medicine, 21*(11), 1273–1277. https://doi:10.1016/0277-9536(85)90277-1

Fuentes, S. (2015). Calls for Government Action on Food Poisoning. Retrieved May 29, 2019, from http://www.freemalaysiatoday.com/category/ nation/2015/04/07/cap-calls-for-govt-action-on-food -poisoning/

Gallo, M., Ferrara, L., Calogero, A., Montesano, D., & Naviglio, D. (2020). Relationships between food and diseases: What to know to ensure food safety, *Food Research International*, *137,* 109414. doi: https://doi.org/10.1016/j.foodres.2020.109414

Garayoa, R., Abundancia, C., Díez-Leturia, M., & Vitas, A.I. (2017). Essential tools for food safety surveillance in catering services: On-site inspections and control of high risk cross-contamination surfaces. *Food Control, 75,* 48-54.

Gardner, B., Abraham, C., Lally, P., & de-Bruijn, G.J. (2012). Towards parsimony in habit measurement: Testing the convergent and predictive validity of an automaticity subscale of the Self-Report Habit Index. *International Journal of Behavioral Nutrition and Physical Activity*, *9*, 102. https://doi.org/10.1186/1479-5868-9-102

Gardner, B. (2015). A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behaviour. *Health Psychology Review*, *9*(3), 277–295. https://doi.org/10.1080/17437199.2013.876238

Gashaw, A., Afework, K., Feleke, M., Moges, T., & Kahsay, H. (2008). Prevalence of bacteria and intestinal parasites among food-handlers in Gondar Town,

Northwest Ethiopia. *Journal of Health, Population and Nutrition*, *26*(4), 451–455.

Ghazali, E., Soon, P. C., Mutum, D. S., & Nguyen, B. (2017). Health and cosmetics: Investigating consumers' values for buying organic personal care products. *Journal of Retailing and Consumer Services*, *39*, 154–163. https://doi.org/10.1016/j.jretconser.2017.08.002

Glanz, K., Rimer, B. K., & Viswanath, K. (2008). Health behavior and health education. Theory, research and practice (4th ed.). USA: Jossey-Bass.

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems*, *18*(1), 185–214. https://doi.org/10.1080/07421222.2001.11045669

Goodhue, D. L., Lewis, W., & Thompson, R. (2012). Does PLS have advantages for small sample size or non-normal data? *MIS Quarterly*, *36*(3), 981–1001.

Green, L. R., Selman, C. A., Radke, V., Ripley, D., Mack, J. C., Reimann, D. W., Stigger, T., Motsinger, M., & Bushnell, L. (2006). Food worker handwashing practices: An observation study. *Journal of Food Protection*, *69*(10), 2417–2423.

Green, Laura R, & Selman, C. (2005). Factors impacting food workers' and managers' safe food preparation practices: A qualitative study. *Food Protection Trends*, *25*(12), 981–990.

Griffith, C. (2000). Food Safety in Catering Establishments. In J.M. Farber, & E.C.D. Todd (Eds.), *Safe handling of foods* (pp. 235-256). New York: Marcel Dekker.

Groβ, M. (2018). Heterogeneity in consumers' mobile shopping acceptance: A finite mixture partial least squares modelling approach for exploring and characterising different shopper segments. *Journal of Retailing and Consumer Services*, 40, 8-18.

Guetterman, T. C., & Creswell, J. W. (2015). Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *Annals Family of Medicine*, 554–561. http://doi.org/10.1370/afm.1865.

Haapala, I. & Probart, C. (2004). Food safety knowledge, perceptions, and behaviors among middle school students. *Journal of Nutrition Education & Behavior, 36(2),* 71–76. doi:10.1016/s1499-4046(06)60136-x

Hague, W.A., Warren, K.E., Hunt, M.C., Kropf, D.H., Kastner, C.L., Stroda, S.L., & Johnson, D.E. (1994). End-point temperature, internal cooked color, and expressible juice color relationships in ground beef patties. *Journal of Food Science, 59*(3), 465-470. https://doi.org/10.1111/j.1365- 2621.1994.tb05539.x

Hair, J. F., Hult, T.M., Ringle, C. M., & Sarstedt, M. (2017). A primer on partial least squares structural equation modeling (PLS SEM) (2nd ed.). USA: SAGE Publications Inc.

Hair, J.F., Hult, G.T.M., Ringle, C.M., & Sarstedt, M. (2014a). A primer on partial least squares structural equation modeling (PLS-SEM). USA: SAGE Publications, Inc. https://doi.org/10.1108/EBR-10-2013-0128

Hair, J.F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. (2014b). Partial least squares

structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review, 26*(2), 106-121. https://doi.org/10.1108/EBR-10-2013-0128

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–151. https://doi.org/10.2753/MTP1069-6679190202

Harris, K. J., Murphy, K. S., Dipietro, R. B., & Line, N. D. (2017). The antecedents and outcomes of food safety motivators for restaurant workers: An expectancy framework. *International Journal of Hospitality Management*, *63*, 53–62. https://doi.org/10.1016/j.ijhm.2017.02.004

Harun, A., Rokonuzzaman, M., Prybutok, G., & Prybutok, V.R. (2018). How to influence consumer mindset: A perspective from service recovery. *Journal of Retailing and Consumer Services*, *42*, 65-77. https://doi.org/10.1016/j.jretconser.2018.01.012

Henroid, D., & Sneed, J. (2004). Readiness to implement hazard analysis and critical control point (HACCP) systems in Iowa schools. *Journal of the American Dietetic Association*, *104*(2), 180–185. https://doi.org/10.1016/j.jada.2003.11.009

Howells, A. D., Roberts, K. R., Shanklin, C. W., Pilling, V. K., Brannon, L. A., & Barrett, B. B. (2008). Restaurant employees' perceptions of barriers to three food safety practices. *Journal of the American Dietetic Association*, *108*, 1345–1349. https://doi.org/10.1016/j.jada.2008.05.010

Hulland, J. (1999). Use of Partial Least Squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal*, *20*(2), 195–204. https://doi.org/10.1002/smj.431

Jenner, E. A., Fletcher, B. (C)., Watson, P., Jones, F. A., Miller, L., & Scott, G. M. (2006). Discrepancy between self-reported and observed hand hygiene behaviour in healthcare professionals. *Journal of Hospital Infection*, *63*(4), 418–422. https://doi.org/10.1016/j.jhin.2006.03.012

Jianu, C., & Chiş, C. (2012). Study on the hygiene knowledge of food handlers working in small and medium-sized companies in western Romania. *Food Control*, *26*(1), 151–156. https://doi.org/10.1016/j.foodcont.2012.01.023

Johnson, R.B., & Onwuegbuzie, A. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(14), 14-26. https://doi.org/10.3102/0013189X033007014

Jones, T. F., Pavlin, B. I., LaFleur, B. J., Ingram, L. A., & Schaffner, W. (2004). Restaurant inspection scores and foodborne disease. *Emerging Infectious Diseases*, *10*(4), 688–692. https://doi.org/10.3201/eid1004.030343

Kaiser, H.F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 1*, 141-151. https://doi.org/https://doi.org/10.1177/001316446002000116

Kennedy, J., Gibney, S., Nolan, A., O'Brien, S., McMahon, M.A.S., McDowell, D., Fanning, S., & Wall., P.G. (2011). Identification of critical points during

domestic food preparation: An observational study. *British Food Journal, 113*(6-7), 766-783. https://doi.org/10.1108/00070701111140106

Keogh-Brown, M., Bachmann, M., Shepstone, L., Hewitt, C., Howe, A., Ramsay, C., Song, F., Miles, J., Torgerson, D., Miles, S., Elbourne, D., Harvey, I., & Campbell, M.J. (2007). Contamination in trials of educational interventions. *Health Technology Assessment, 11*(43), 1–130.

Kline, R.B. (2011). Principles and practice of structural equation modelling. New York: The Guilford Press.

Kock, N., & Hadaya, P. (2018). Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. *Information Systems Journal*, *28*(1), 227–261. https://doi.org/10.1111/isj.12131

Kor, K., & Mullan, B. A. (2011). Sleep hygiene behaviours: An application of the theory of planned behaviour and the investigation of perceived autonomy support, past behaviour and response inhibition. *Psychology and Health*, *26*(9), 1208–1224. https://doi.org/10.1080/08870446.2010.551210

Krueger, R.A., & Casey, M.A. (2015). Focus groups: A practical guide for applied research (5th ed.). USA: SAGE Publications, Inc.

Lally, P. & Gardner, B. (2013). Promoting habit formation. *Health and Psychology Reviews, 7*, 137-158.

Lee, B. (2013). Food Safety Interventions - A Review of Food Safety Interventions and Evaluation in Food Service Establishments. *NCCEH National Collaborating Centre*, (September), 1–53.

Lee, H. Y., Chik, W. N. W., Bakar, F. A., Saari, N., & Mahyudin, N. A. (2012). Sanitation practices among food handlers in a military food service institution, Malaysia. *Food and Nutrition Sciences, 3(11),* 1561–1566. https://doi.org/10.4236/fns.2012.311204

Lee, L. L., Arthur, A., & Avis, M. (2008). Using self-efficacy theory to develop interventions that help older people overcome psychological barriers to physical activity: A discussion paper. *International Journal of Nursing Studies*, *45*(11), 1690–1699. https://doi.org/10.1016/j.ijnurstu.2008.02.012

Lee, H., Abdul Halim, H., Thong, K., & Chai, L. (2017). Assessment of food safety knowledge, attitude, self-reported practices, and microbiological hand hygiene of food handlers. *International Journal of Environmental Research and Public Health, 14*(1), 55.

Lelieveld, H., Holah, J., & Gabric, D. (2016). Handbook of hygiene control in the food industry (2nd ed.). UK: Woodhead Publishing Limited.

Lin, C. –T. J. (2018). Self-reported methods used to judge when a hamburger is ready at-home in a sample of U.S. adults. *Food Control, 91*, 181-184.

Lues, J. F. R., & Van Tonder, I. (2007). The occurrence of indicator bacteria on hands and aprons of food handlers in the delicatessen sections of a retail group. *Food Control*, *18*(4), 326–332. https://doi.org/10.1016/j.foodcont.2005.10.010

Luszczynska, A., Tryburcy, M., & Schwarzer, R. (2007). Improving fruit and vegetable consumption: A self-efficacy intervention compared with a combined self-efficacy and planning intervention, *22*(5), 630–638. https://doi.org/10.1093/her/cyl133

Malay Mail (2018). These are the main culprits behind Perak food poisoning cases, says state exco. Retrieved on October 8, 2019 from https://www.malaymail.com/news/malaysia/2018/10/11/these-are-the-main-culprits-behind-perak-food-poisoning-cases-says-state-ex/1681818

MalaysiaGazette. (2020, October 6). Kembalikan hak eksklusif jual makanan, minuman kepada kantin sekolah. Retrieved from https://malaysiagazette.com/2020/10/06/kembalikan-hak-eksklusif-jual-makanan-minuman-kepada-kantin-sekolah/

Martins, M.L., & Rocha, A. (2014). Evaluation of prerequisite programs implementation at schools foodservice. *Food Control*, *39*(1), 30–33. https://doi.org/10.1016/j.foodcont.2013.10.040

Mazaheri, M. A., & Heidarnia, A. (2015). The effect of intervention based on Health Action Model to promote workers ' safe behavior in Isfahan Steel Company. *Journal of Education and Health Promotion, 4*, 64. *https*://doi.org/10.4103/2277-9531.162385

Mcfarland, P., Sielaff, A. C., Rasco, B., & Smith, S. (2019). Efficacy of food safety training in commercial food service. *Journal of Food Science, 84*(6), 1239–1246. https://doi.org/10.1111/1750-3841.14628

McArthur, L. H., Holbert, D., & Forsythe, W. A. (2006). Compliance with food safety recommendations among university undergraduates: Application of the Health Belief Model. *Family and Consumer Sciences Research Journal, 35*(2), 160–170. doi:10.1177/1077727x06292932

McIntyre, L., Peng, D., & Henderson, S. B. (2014). Retraining effectiveness in FOODSAFE trained food handlers in British Columbia, Canada. *Food Control, 35*(1), 137–141. https://doi:10.1016/j.foodcont.2013.06.028

McIntyre, L., Vallaster, L., Wilcott, L., Henderson, S. B., & Kosatsky, T. (2013). Evaluation of food safety knowledge, attitudes and self-reported handwashing practices in FOODSAFE trained and untrained food handlers in British Columbia, Canada. *Food Control*, *30*(1), 150–156. https://doi.org/10.1016/j.foodcont.2012.06.034

Meacham, S. (2016). Peer relationships and internally persuasive discourse. *Learning, Culture and Social Interaction*, *9*, 95–104. https://doi.org/10.1016/j.lcsi.2016.02.004

Medeiros, C. O., Cavalli, S. B., Salay, E., & Proença, R. P. C. (2011). Assessment of the methodological strategies adopted by food safety training programmes for food service workers: A systematic review. *Food Control*, *22*(8), 1136–1144. https://doi.org/10.1016/j.foodcont.2011.02.008

Medeiros, L.C., Hillers, V.N., Kendall, P.A., & Mason, A. (2001). Food safety education: What should we be teaching to consumers? *Journal Nutrition*

Education, 33(2), 108-113.

Michie, S., Rothman, A. J., & Sheeran, P. (2007). Current issues and new direction in Psychology and Health: Advancing the science of behavior change. *Psychology and Health, 22,* 249–253.

Ministry of Education Malaysia. (2018). Quick Facts 2018. Malaysia Educational Statistics ISSN: 1985-6407 July 2018. Educational Data Sector Educational Planning and Research Division Ministry of Education Malaysia, Putrajaya. https://www.moe.gov.my/muat-turun/laporan-dan-statistik/quick-facts-malaysia-education-statistics/563-quick-facts-2018-malaysia-educational-statistics/file.

Ministry of Health Malaysia. (2013). 7 Langkah mencuci tangan yang betul. (Publication No. KKM/BM/1,500/2013). Bahagian Pendidikan Kesihatan Kementerian Kesihatan Malaysia. https://www.infosihat.gov.my/index.php/multimedia/lain-lain/item/7-langkah-mencuci-tangan-yang-betul/.

Ministry of Health Malaysia. (2018a). Annual Report 2018. http://vlib.moh.gov.my/cms/documentstorage/com.tms.cms.document.Document_a84bb50c-a0188549-11840c30-86638f00/anr-bi-2018.pdf

Ministry of Health Malaysia. (2018b). Garis Panduan Pelaksanaan Pemakanan Sihat di Sekolah. https://ecepakk3243tk.files.wordpress.com/2018/02/panduan-hidangan-sihat-di-kantin-sekolah.pdf

Ministry of Health Malaysia. (2021). Program Pemeriksaan Sendiri (KENDIRI) di Sekolah. http://fsq.moh.gov.my/v6/xs/page.php?id=235

Moss-Morris, R., & Yardley, L. (2008). Current issues and new directions in Psychology and Health: Contributions to translational research. *Psychology & Health, 23*, 1–4.

Mullan, B. A., & Wong, C. (2009). Hygienic food handling behaviours. An application of the Theory of Planned Behaviour. *Appetite, 52*, 757–761.

Mullan, B. A., Wong, C., & Kothe, E. J. (2013). Predicting adolescents' safe food handling using an extended theory of planned behavior. *Food Control*, *31*(2), 454–460. https://doi.org/10.1016/j.foodcont.2012.10.027

Mullan, B.A., Allom, V., Fayn, K., & Johnston, I. (2014). Building habit strength: A pilot intervention designed to improve food-safety behavior. *Food Research International*, *66*, 274–278. https://doi.org/10.1016/j.foodres.2014.09.027

Mullan, B., Allom, V., Sainsbury, K., & Monds, L. A. (2015). Examining the predictive utility of an extended theory of planned behaviour model in the context of specific individual safe food-handling. *Appetite*, *90*, 91–98. https://doi.org/10.1016/j.appet.2015.02.033

Mullan, B., & Wong, C. (2010). Using the Theory of Planned Behaviour to design a food hygiene intervention. *Food Control*, *21*(11), 1524–1529. https://doi.org/10.1016/j.foodcont.2010.04.026

Musa, M., Khalid, K., & Anuar, J. (2015). Assessment of food temperature and food holding time among cafeterias in UiTM Dungun Terengganu. *Journal of Applied*

Environmental and Biological Sciences, *5*, 21–27.

Naidoo, J., & Wills, J. (2000). Health promotion: Foundations for practice (2nd ed.). London: Bailliere Tindall.

New, C.Y., Ubong, A., Premarathne, J.M.K.J.K., Thung, T.Y., Lee, E., Chang, W. S., Loo, Y.Y., Kwan, S.Y., Tan, C.W., Kuan, C.H., & Son, R. (2017). Microbiological food safety in Malaysia from the academician's perspective. *Food Research*, *1*(6), 183–202. https://doi.org/10.26656/fr.2017.6.013

New Straits Times. (2018, October 22). Laksa poisoning caused by salmonella. *New Straits Times*. Retrieved from https://www.nst.com.my/news/nation/2018/10/423469/laksa-poisoning-caused-salmonella

New Straits Times (2019, July 13). Food poisoning cases up by 24 pc last year. New Straits Times. Retrieved from https://www.nst.com.my/news/nation/2019/07/504036/food-poisoning-cases-24pc-last-year/

Nieto-Montenegro, S., Brown, J. L., & LaBorde, L. F. (2006). Using the Health Action Model to plan food safety educational materials for Hispanic workers in the mushroom industry. *Food Control*, *17*(10), 757–767. https://doi.org/10.1016/j.foodcont.2005.04.017

Nieto-Montenegro, S., Brown, J. L., & LaBorde, L. F. (2008). Development and assessment of pilot food safety educational materials and training strategies for Hispanic workers in the mushroom industry using the Health Action Model. *Food Control*, *19*(6), 616–633.

Nik Rosmawati N. H., Wan Manan W. M., Noor Izani N. J., Nik Nurain, N. H., & Razlina, A. R. (2018). The effect of food safety education on handwashing practices in school canteens' food handlers. *Sains Malaysiana*, *47*(9), 2119–2128. https://doi.org/10.17576/jsm-2018-4709-21

Noar, S. M., & Zimmerman, R. S. (2005). Health behavior theory and cumulative knowledge regarding health behaviors: are we moving in the right direction? *Health Education Research*, *20*(3), 275–290. https://doi.org/10.1093/her/cyg113

Norazmir, M. N., Hasyimah, M. A. N., Shafurah, A. S., Sabariah, B. S., Ajau, D., & Norazlanshah, H. (2012). Knowledge and practices on food safety among secondary school students in Johor Bahru , Johor , Malaysia. *Pakistan Journal of Nutrition*, *11*(2), 110–115.

Nunnally, J.C., & Bernstein, I. H. (1999). *Journal of Psychoeducational Assessment*, *17*, 275–280.

Oudeyer, P.-Y., & Kaplan, F. (2008). How can we define intrinsic motivation? *Most,* 93–101. https://doi.org/10.1017/CBO9781107415324.004

Paez, P., Strohbehn, C. H., & Sneed, J. (2007a). Developing benchmarks for handwashing in retail foodservice operations: a pilot study in delicatessens. *Food Protection Trends, 27*(11), 903–908.

Paez, P., Strohbehn, C. & Sneed, J. (2007b). Handwashing frequencies and methods

used in deli-type foodservice operations. *Food Protection Trends,* 29, 903–908.

Park, S. H., Kwak, T. K., & Chang, H. J. (2010). Evaluation of the food safety training for food handlers in restaurant operations. *Nutrition Research and Practice, 4*(1), 58-68.

Pellegrino, R., Crandall, P. G., Bryan, C. A. O., & Seo, H. (2015). A review of motivational models for improving hand hygiene among an increasingly diverse food service workforce. *Food Control*, *50*, 446–456. https://doi.org/10.1016/j.foodcont.2014.09.015

Phang, H.S., & Bruhn, C. (2011). Burger preparation: What consumers say and do in the home. *Journal of Food Protection, 74*(10), 1708-1716.

Pilling, V. K., Brannon, L. A., Shanklin, C. W., Howells, A. D., & Roberts, K. R. (2008). Identifying specific beliefs to target to improve restaurant employees' intentions for performing three important food safety behaviors. *Journal of the American Dietetic Association*, *108*(6), 991–997. https://doi.org/10.1016/j.jada.2008.03.014

Pilling, V. K., Brannon, L. A., Shanklin, C. W., Roberts, K. R., Barrett, B. B., & Howells, A. D. (2008). Food safety training requirements and food handlers ' knowledge and behaviors. *Food Protection Trends*, *28*(3), 192–200.

Ramayah, T. , Cheah, J., Chuah, F., Ting, H., & Memon, M.A. (2018). Partial least squares structural equation modeling (PLS-SEM) using SmartPLS 3.0. (2nd ed.). Malaysia: Pearson.

Redmond, E. C., & Griffith, C. J. (2003). Consumer food handling in the home: A review of food safety studies. *Journal of Food Protection*, *66*(1), 130–161. https://doi.org/10.4315/0362-028X-66.1.130

Reinartz, W., Haenlein, M., & Henseler, J. (2009). An empirical comparison of the efficacy of covariance-based and variance-based SEM. *International Journal of Research in Marketing*, *26*(4), 332–344. https://doi.org/10.1016/j.ijresmar.2009.08.001

Rennie, D. M. (1995). Health education models and food hygiene education. *Journal of the Royal Society of Health*, *1*(2), 75–79.

Resnick, B. (2002). Evaluating the components of the Exercise Plus Program: rationale, theory and implementation. *Health Education Research*, *17*(5), 648–658. https://doi.org/10.1093/her/17.5.648

Ringle, C. M., & Sarstedt, M. (2016). Gain more insight from your PLS-SEM results the importance-performance map analysis. *Industrial Management and Data Systems*. *116*(9), 1865-1886. https://doi.org/10.1108/IMDS-10-2015-0449

Ringle, C.M., Wende, S., & Becker, J.-M. (2015). "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com/ Accessed 11 October 2019.

Roberts, K. R., Arendt, S. W., Strohbehn, C., Ellis, J. D., & Paez, P. (2012). Educating future managers to motivate employees to follow food safety practices. *Journal of Management & Education*, *6*(1), 1–8. https://doi.org/10.1108/eb017384

Roberts, K. R., Barrett, B. B., Howells, A. D., Shanklin, C. W., Pilling, V. K., & Brannon, L. A. (2008). Food safety training and foodservice employees' knowledge and behavior. *Food Protection Trends*, *28*(4), 252–260.

Robertson, L. a., Boyer, R. R., Chapman, B. J., Eifert, J. D., & Franz, N. K. (2013). Educational needs assessment and practices of grocery store food handlers through survey and observational data collection. *Food Control*, *34*(2), 707–713. https://doi.org/10.1016/j.foodcont.2013.06.004

Roden, J. (2004). Revisiting the health belief model: Nurses applying it to young families and their health promotion needs. *Nursing and Health Sciences, 6,* 1–10.

Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social Learning Theory and the Health Belief Model. *Health Education & Behavior*, *15*(2), 175–183. https://doi.org/10.1177/109019818801500203

Rowan, N., & Wulff, D. (2007). Using qualitative methods to inform scale development. *The Qualitative Report,* 12(3), 450-466. https://doi.org/10.1177/1362361315601012

Ruby, G. E., Ungku Zainal Abidin, U. F., Lihan, S., Jambari, N. N., & Radu, S. (2019). Predicting intention on safe food handling among adult consumers: A cross sectional study in Sibu district, Malaysia. *Food Control*, *106*, 106696. https://doi.org/10.1016/j.foodcont.2019.06.022

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Ryu, J. H., Ko, J., Park, H., Yang, S., & Kim, H. (2011). Microbial examination of nonheated foods served in feeding programs of elementary schools, Iksan city, Jeonbuk province, Korea. *Journal of Food Protection*, *74*(9), 1564–1568. https://doi.org/10.4315/0362-028X.JFP-11-009

Salleh, W., Lani, M. N., Abdullah, W. Z. W., Chilek, T. Z. T., & Hassan, Z. (2017). A review on incidences of foodborne diseases and interventions for a better national food safety system in Malaysia. *Malaysian Applied Biology*, *46*(3), 1–7.

Sampers, I., Berkvens, D., Jacxsens, L., Ciocci, M.C., Dumoulin, A., & Uyttendaele, M. (2012). Survey of Belgian consumption patterns and consumer behavior of poultry meat to provide insight in risk factors for campylobacteriosis. *Food Control*, 26(2), 293-299.

Santos, M.-J., Nogueira, J. R., Patarata, L., & Mayan, O. (2008). Knowledge levels of food handlers in Portuguese school canteens and their self-reported behaviour towards food safety. *International Journal of Environmental Health Research*, *18*(6), 387–401. https://doi.org/10.1080/09603120802100212

Sarter, G., & Sarter, S. (2012). Promoting a culture of food safety to improve hygiene in small restaurants in Madagascar. *Food Control*, *25*(1), 165–171. https://doi.org/10.1016/j.foodcont.2011.10.023

Seaman, P., & Eves, A. (2006). The management of food safety-the role of food hygiene training in the UK service sector. *International Journal of Hospitality*

Management, *25*(2), 278–296. https://doi.org/10.1016/j.ijhm.2005.04.004

Shapiro, M. A., Porticella, N., Jiang, L. C., & Gravani, R. B. (2011). Predicting intentions to adopt safe home food handling practices. Applying the theory of planned behavior. *Appetite*, *56*(1), 96–103. https://doi.org/10.1016/j.appet.2010.11.148

Sharif, L., & Al-Malki, T. (2010). Knowledge, attitude and practice of Taif University students on food poisoning. *Food Control*, *21*(1), 55–60. https://doi.org/10.1016/j.foodcont.2009.03.015

Sharif, L., Obaidat, M. M., & Al-Dalalah, M.-R. (2013). Food hygiene kowledge, attitudes and practices of the food handlers in the military hospitals. *Food and Nutrition Sciences*, *04*(03), 245–251. https://doi.org/10.4236/fns.2013.43033

Sharifa Ezat, W. P., Netty, D., & Sangaran, G. (2013). Paper review of factors, surveillance and burden of food borne disease outbreak in Malaysia. *Malaysian Journal of Public Health Medicine*, *13*(2), 1–7.

Sharoni, S. K. A., Rahman, H. A., Minhat, H. S., Shariff-Ghazali, S., & Ong, M. H. A. (2018). The effects of self-efficacy enhancing program on foot self-care behaviour of older adults with diabetes: A randomised controlled trial in elderly care facility, Peninsular Malaysia. *PLoS ONE*, *13*(3), 1–23. https://doi.org/10.1371/journal.pone.0192417

Siau, M. F. (2015). Food court hygiene assessment and food safety knowledge, attitudes and practices of food handlers in Putrajaya. *International Food Research Journal*, *22*(5), 1843–1854.

Siebert, M. M., Perry, C., O'Connell, L., Albrecht, J., Stenger, K., & Vlasin-Marty, K. (2014). A mixed methods approach to investigating food safety behavior in a sample of Native American and Hispanic caregivers of young children. *Journal of Food Research*, *3*(5), 59. https://doi.org/10.5539/jfr.v3n5p59

Silverman, D. (2006). Qualitative research: Theory, method and practice (2nd ed.). London: SAGE Publications Ltd.

Siow, O. N., & Sani, N. A. (2011). Assessment of knowledge, attitudes and practices (KAP) among food handlers at residential colleges and canteen regarding food safety. *Sains Malaysiana, 40*(4), 403-410.

Smigic, N., Djekic, I., Martins, M. L., Rocha, A., Sidiropoulou, N., & Kalogianni, E. P. (2016). The level of food safety knowledge in food establishments in three European countries. *Food Control*, *63*, 187–194. https://doi.org/10.1016/j.foodcont.2015.11.017

Smith, J. L., & Fratamico, P. M. (2017). *Escherichia coli* as a Pathogen. In *Foodborne Diseases: Third Edition* (pp. 189–103). Elsevier Inc. https://doi.org/10.1016/B978-0-12-385007-2.00007-3

Sneed, J., & Henroid, D. (2007). Impact of educational interventions on Hazard Analysis Critical Control Point (HACCP) program implementation in Iowa Schools. *The Journal of Child Nutrition & Management, 31*(1), 1-8.

Soares, L. S., Almeida, R. C. C., Cerqueira, E. S., Carvalho, J. S., & Nunes, I. L.

(2012). Knowledge, attitudes and practices in food safety and the presence of coagulase-positive staphylococci on hands of food handlers in the schools of Camaçari, Brazil. *Food Control*, *27*(1), 206–213. https://doi.org/10.1016/j.foodcont.2012.03.016

Soon, J. M., & Baines, R. N. (2012). Food safety training and evaluation of handwashing intention among fresh produce farm workers. *Food Control*, *23*(2), 437–448. https://doi.org/10.1016/j.foodcont.2011.08.012

Soon, J. M., Singh, H., & Baines, R. (2011). Foodborne diseases in Malaysia: A review. *Food Control*, *22*(6), 823–830. https://doi.org/10.1016/j.foodcont.2010.12.011

Soon, J. M. (2019). Finger licking good? An observational study of hand hygiene practices of fast food restaurant employees and consumers. *British Food Journal*, *121*(3), 697-710. https://doi.org/10.1108/BFJ-07-2018-0420

Strohbehn, C., Shelley, M., Arendt, S., Correia, A. P., Meyer, J., Abidin, U. F. U. Z., & Jun, J. (2014). Retail foodservice employees1 perceptions of barriers and motivational factors that influence performance of safe food behaviors. *Food Protection Trends*, *34*(3), 139–150.

Strohbehn, C., Sneed, J., Paez, P., & Meyer, J. (2008). Hand washing frequencies and procedures used in retail food services. *Journal of Food Protection*, *71*(8), 1641–1650. https://doi.org/10.4315/0362-028x-71.8.1641

Sultan, P., Tarafder, T., Pearson, D., & Henryks, J. (2020). Intention-behaviour gap and perceived behavioural control-behaviour gap in theory of planned behaviour: Moderating roles of communication, satisfaction and trust in organic food consumption. *Food Quality and Preference*, *81*, 103838. https://doi.org/10.1016/j.foodqual.2019.103838

Suri, H. (2011). Purposeful sampling in qualitative research synthesis. *Qualitative Research Journal*, *11*(2), 63–75. https://doi.org/10.3316/QRJ1102063

Strohbehn, C.H., Paez, P., Sneed, J., & Meyer, J. (2011). Mitigating cross contamination in four retail foodservice sectors. *Food Protection Trends, 31*(10), 620-630.

Takeda, S., Akamatsu, R., Horiguchi, I., & Marui, E. (2011). Relationship among food-safety knowledge, beliefs, and risk-reduction behavior in university students in Japan. *Journal of Nutrition Education and Behavior*, *43*(6), 449–454. https://doi.org/10.1016/j.jneb.2010.08.009

Tan, S. L., Cheng, P. L., Soon, H. K., Ghazali, H., & Mahyudin, N. A. (2013). A qualitative study on personal hygiene knowledge and practices among food handlers at selected primary schools in Klang valley area, Selangor, Malaysia. *International Food Research Journal*, *20*(1), 71–76.

Tan, Siew Lian, Bakar, F. A., Abdul Karim, M. S., Lee, H. Y., & Mahyudin, N. A. (2013). Hand hygiene knowledge, attitudes and practices among food handlers at primary schools in Hulu Langat district, Selangor (Malaysia). *Food Control*, *34*(2), 428–435. https://doi.org/10.1016/j.foodcont.2013.04.045

Taylor, J. H., Brown, K. L., Toivenen, J., & Holah, J. T. (2000). A microbiological

evaluation of warm air driers with respect to hand hygiene and the washroom environment. *Journal of Applied Microbiology,* 89(6), 910-919.

Tewari, A., & Abdullah, S. (2015). *Bacillus cereus* food poisoning: international and Indian perspective. *Journal of Food Science and Technology*, *52*(5), 2500–2511. https://doi.org/10.1007/s13197-014-1344-4

Thaivalappil, A., Waddell, L., Greig, J., Meldrum, R., & Young, I. (2018). A systematic review and thematic synthesis of qualitative research studies on factors affecting safe food handling at retail and food service. *Food Control, 89,* 97-107. https://doi.org/10.1016/j.foodcont.2018.01.028

The Sun Daily (2016, April 28). Food poisoning in schools increase 57%, says Health Ministry. *The Sun Daily.* Retrieved from https://www.thesundaily.my/archive/1782938-DSARCH363909/

Thompson, B. M., & Knight, S. L. (2006). Determining the food irradiation beliefs of community nutrition educators: Do beliefs influence educational outreach? *Journal of Nutrition Education and Behavior*, *38*(1), 50–55. https://doi.org/10.1016/j.jneb.2005.11.002

Todd, E. C. D., Michaels, B. S., Smith, D., & Greig, J. D. (2010). Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 9 . Washing and drying of hands to reduce microbial contamination. *Journal of Food Protection*, *73*(10), 1937–1955.

Tones, K., & Tilford, S. (1994). Health education. Effectiveness, efficiency and equity. (2nd ed.). London: Chapman and Hall.

Tones, K. (1987). Devising strategies for preventing drug misuse: The role of the Health Action Model. *Health Education Research, 2(4), 305-317.* https://doi:10.1093/her/2.4.305

Tóth, A. J., & Bittsánszky, A. (2014). A comparison of hygiene standards of serving and cooking kitchens in schools in Hungary. *Food Control*, *46*, 520–524. https://doi.org/10.1016/j.foodcont.2014.06.019

Tóth, A. J., Koller, Z., Illés, C. B., & Bittsánszky, A. (2017). Development of conscious food handling in Hungarian school cafeterias. *Food Control*, *73*, 644–649. https://doi.org/10.1016/j.foodcont.2016.09.011

Ungku Fatimah, U. Z. A., Strohbehn, C. H., & Arendt, S. W. (2014). An empirical investigation of food safety culture in onsite foodservice operations. *Food Control*, *46*, 255–263. https://doi.org/10.1016/j.foodcont.2014.05.029

USDA. (2020). What is the difference between foodborne illness and food poisoning? https://ask.usda.gov/s/article/What-is-the-difference-between-foodborne-illness-and-food-poisoning

US FDA. (2000). Report of the FDA retail food program database of foodborne illness risk factors. http://www.fda.gov/Food/ GuidanceRegulation/RetailFoodProtection/ FoodborneIllnessRiskFactorReduction/ucm123544.htm./

US FDA. (2013). USDA Food Code.

http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm374275.htm/

US FDA. (2017). Food code. U.S Department of Health and Human Services, Public Health Service, Food and Drug Administration. https://www.fda.gov/media/110822/download.

US FDA (2018). *FDA report on the occurrence of foodborne illness risk factors in fast food and full-service restaurants*, *2013-2014*. *US: FDA National Retail Food Team.* https://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/FoodborneIllnessRiskFactorReduction/UCM625005.pdf/

van't Riet, J., Sijtsema, S. J., Dagevos, H., & de Bruijn, G. J. (2011). The importance of habits in eating behaviour. An overview and recommendations for future research. *Appetite*, *57*(3), 585–596. https://doi.org/10.1016/j.appet.2011.07.010

Van, J. J., & Bijl. (2001). Self-efficacy theory and measurement. *Scholarly Inquiry for Nursing Practice, 15*(13), 189-207.

Vaz, M. L. S., Novo, N. F., Sigulem, D. M., & Morais, T. B. (2005). A training course on food hygiene for butchers: Measuring its effectiveness through microbiological analysis and the use of an inspection checklist. *Journal of Food Protection*, *68*(11), 2439–2442. https://doi.org/10.4315/0362-028X-68.11.2439

Veiros, M. B., Proença, R. P. C., Santos, M. C. T., Kent-Smith, L., & Rocha, A. (2009). Food safety practices in a Portuguese canteen. *Food Control*, *20*(10), 936–941. https://doi.org/10.1016/j.foodcont.2009.02.002

Verplanken, B., & Orbell, S. (2003). Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, *33*(6), 1313–1330. https://doi.org/10.1111/j.1559-1816.2003.tb01951.x

Webb, M., & Morancie, A. (2015). Food safety knowledge of foodservice workers at a university campus by education level, experience, and food safety training. *Food Control*, *50*, 259–264. https://doi.org/10.1016/j.foodcont.2014.09.002

Wong Riff, K.W.Y., Tsangaris, E., Goodacre, T., Forrest, C.R., Pusic, A.L., Cano, S.J., & Klassen, A.F. (2017). International multiphase mixed methods study protocol to develop a cross-cultural patient-reported outcome intrument for children and young adults with cleft lip and/ or palate (CLEFT-Q). *BMJ Open, 7*(1), e015467. https://doi.org/10.1136/bmjopen-2016-015467

Wood, W., Quinn, J. M., & Kashy, D. A. (2002). Habits in everyday life: Thought, emotion, and action. *Journal of Personality and Social Psychology, 83*(6), 1281–1297. https://doi:10.1037/0022-3514.83.6.1281

World Health Organization. (2006). Five keys to safer food manual. http://www.who.int/entity/foodsafety/publications/consumer/manual__keys.pdf.

World Health Organization. (2008). Foodborne disease outbreak. Guidelines for investigation and control. http://www.who.int/foodsafety/publications/foodborne_disease/Annex_7.pdf.

World Health Organization. (2009). WHO guidelines on hand hygiene in health care: a

summary. *World Health Organization*, *30*(1), 270. https://doi.org/10.1086/600379

World Health Organization. (2019a). Food safety: Key facts. https://www.who.int/news-room/fact-sheets/detail/food-safety/

World Health Organization. (2019b). Infographics: Estimates of the global burden of foodborne diseases. https://www.who.int/foodsafety/areas_work/foodborne-diseases/ferg_infographics/en/

World Health Organization. (2019c). Food safety. https://www.who.int/health-topics/food-safety/

Woh, P. Y., Thong, K. L., Behnke, J. M., Lewis, J. W., & Mohd Zain, S. N. (2016). Evaluation of basic knowledge on food safety and food handling practices amongst migrant food handlers in Peninsular Malaysia. *Food Control*, *70*, 64–73. https://doi.org/10.1016/j.foodcont.2016.05.033

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review*, *114*(4), 843–863. https://doi.org/10.1037/0033-295X.114.4.843

Yang, S., Angulo, F. J., & Altekruse, S. F. (2000). Evaluation of safe food-handling instructions on raw meat and poultry products. *Journal of Food Protection*, *63*(10), 1321–1325. https://doi.org/10.4315/0362-028X-63.10.1321

Yarrow, L., Remig, V. M., & Higgins, M. M. (2009). Food safety educational intervention positively influences college students' food safety attitudes, beliefs, knowledge, and self-reported practices. *Journal of Environmental Health*, *71*(6), 30–35.

Yiannas, F. (2009). Food safety culture. Creating a behavior-based food safety management system. America: Springer Science.

York, V., Brannon, L., Shanklin, C., Roberts, K., Howells, A., & Barrett, E. (2009). Foodservice employees benefit from interventions targeting barriers to food safety. *Journal of the American Dietetic Association*, 109(9), 1576-1581.

York, V. K., Brannon, L. A., Roberts, K. R., Shanklin, C. W., & Howells, A. D. (2009). Using the theory of planned behavior to elicit restaurant employee beliefs about food safety: Using surveys versus focus groups. *Journal of Foodservice Business Research*, *12*(2), 180–197. https://doi.org/10.1080/15378020902910777

York, V. K., Brannon, L. A., Shanklin, C. W., Roberts, K. R., Barrett, B. B., & Howells, A. D. (2009). Intervention improves restaurant employees' food safety compliance rates. *International Journal of Contemporary Hospitality Management*, *21*(4), 459–478. https://doi.org/10.1108/09596110910955703

York, V. K., Brannon, L. A., Roberts, K. R., Shanklin, C. W., Howells, A. D., & Barre, E. B. (2012). Effects of observing employees for food safety compliance. *Journal of Foodservice Management & Education*, *6*(1), 17–24.

Yu, H., Neal, J., Dawson, M., & Madera, J. M. (2018). Implementation of behavior-based training can improve food service employees' handwashing frequencies, duration, and effectiveness. *Cornell Hospitality Quarterly*, *59*(1), 70–77.

https://doi.org/10.1177/1938965517704370

Zain, M. M., Naing, N. N., & Sains, U. (2002). Sociodemographic characteristics of food handlers and their knowledge, attitude and practice towards food sanitation: A preliminary report. *Southeast Asian Journal of Tropical Medicine and Public Health, 33(*2), 410-417.

Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., & Alavi-, H. (2015). Design and implementation content validity study: Development of an instrument for measuring patient-centered communication. *Journal of Caring Sciences, 4*(2), 165–178. https://doi.org/10.15171/jcs.2015.017

Zanin, L. M., da Cunha, D. T., de Rosso, V. V., Capriles, V. D., & Stedefeldt, E. (2017). Knowledge, attitudes and practices of food handlers in food safety: An integrative review. *Food Research International*, *100*, 53–62. https://doi.org/10.1016/j.foodres.2017.07.042

Zhang, W. (2014). Mixed methods application in health intervention research: A multiple case study. *International Journal of Multiple Research Approaches*, *8*(1), 24–35. https://doi.org/10.5172/mra.2014.8.1.24

BIODATA OF STUDENT

Stephenie Wong Yoke Wei is a PhD candidate from Universiti Putra Malaysia, in the area of food safety. She graduated with an honors degree in Food Science and Technology and Master of Science in Food Biotechnology from the same university, in the year 2000 and 2007, respectively.

She is currently a senior lecturer with the Faculty of Applied Sciences, UCSI University, Malaysia. Since joining UCSI University in 2006, she has been teaching Food Microbiology, Advanced Food Safety and Quality, Food safety and Quality System, Microbiology, Halal & Food Legislation, Contemporary Issues in Food Science, Food and Nutrition, and the Academic Communication course. At the university, she is also an appointed internal auditor for ISO 9001:2005. Her past roles at UCSI include the Head of Food Science and Nutrition Department from 2010 - 2014, chairperson of Faculty Board Quality Assurance and Enhancement committee, member of Faculty Examination Board (FEB) committee and member of Faculty Board Regulations, Examination and Assessment Committee.

Currently, she is a certified trainer for the food handler training program under the Ministry of Health Malaysia and has been actively conducting trainings for the past two years. In addition, she has successfully passed the lead auditor course in ISO 22000. Her research interest includes food safety in foodservice operations, probiotic studies and microencapsulation work.

LIST OF PUBLICATION

Journal

Wong, S. Y. W., Ahmad, I. A., Ho, J. A., Mahyudin, N. A., & Ungku Zainal Abidin, U. F. (2020). Insight into food handlers' perceived barriers and motivators to perform food temperature control practices in Malaysian public schools. *Food Research, 4*(3), 793-804.

Conference Presentation

Wong, S. Y. W., Mahyudin, N. A., Ho, J. A., & Ungku Zainal Abidin, U. F. (2016). Perceiveed barriers and motivators of school food hadlers to using food thermometers in Klang Valley, Malaysia. Presented at 4th Asia-Pacific International Food Safety Conference & 7th Asian Conference on Food and Nutrition Safety. 11-13 October 2016. Penang, Malaysia.

Wong, S. Y. W., Ahmad, I. A., Mahyudin, N. A., Ho, J. A., & Ungku Zainal Abidin, U. F. (2019). Needs assessment and the development of a self-efficacy-building intervention to improve food handlers' handwashing practices in Klang Valley school canteens. Presented at 2nd International Food Research Conference 2019. 27–29 August 2019. Putrajaya, Malaysia.

UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : _____

TITLE OF THESIS / PROJECT REPORT :

_____

_____

_____

NAME OF STUDENT : _____

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (√)

☐	**CONFIDENTIAL**	(Contain confidential information under Official Secret Act 1972).
☐	**RESTRICTED**	(Contains restricted information as specified by the organization/institution where research was done).
☐	**OPEN ACCESS**	I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

☐	**PATENT**	Embargo from_____ until _____ (date) (date)

Approved by:

_____	_____
(Signature of Student)	(Signature of Chairman of Supervisory Committee)
New IC No/ Passport No.:	Name:
Date :	Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]