

Exploration of Healthy Eating and Gestational Weight Gain Behaviours among Pregnant Women in Vietnam: A Qualitative Study and Logic Model for Developing Interventions

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Abstract

Pregnant Vietnamese women often experience undernutrition and inadequate weight gain, which can cause health problems for both mother and foetus. Previous interventions targeting healthy eating and gestational weight gain (GWG) had limited success and a lack of understanding about influencing factors. This study explores factors affecting healthy eating and GWG behaviours, aiming to develop a logic model for interventions promoting healthy behaviours during pregnancy for Vietnamese women.

Qualitative study used online focus groups with 20 pregnant Vietnamese women. Through thematic analysis, themes were identified and then mapped using the COM-B model and theoretical domains framework. A logic model for interventions was developed using the Scottish Government's 5-step approach for behaviour change interventions.

Three key aspects- capabilities, opportunities, and motivations- provide insight into healthy eating and GWG behaviours. Analysis revealed that women combined traditional and scientific knowledge to inform their healthy eating and GWG behaviour, despite incomplete knowledge. Additionally, inconsistent adherence to prenatal micronutrient supplements stemmed from misconceptions about their preventive benefits. Women showed proactive self-care and sought information on healthy eating and GWG during pregnancy but challenged obtaining healthcare professionals' advice. Instead, they relied on informal sources like social media and advice from family members, finding them accessible and convenient for gathering information at their own pace and seeking reassurance from others' experiences. Nevertheless, the relatability and trustworthiness of information from informal sources, rooted in personal experiences and cultural beliefs (e.g., food belief and taboos), emphasize the influence of social and cultural factors on knowledge and decision-making. Thus, a logic model for mobile health intervention was developed to promote healthy eating by addressing barriers and outlining required resources and outcomes.

Study unveils factors influencing healthy eating and GWG, informing a logic model for a mobile health intervention to promote these behaviours. The study lays the groundwork for future intervention development.

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List of Abbreviations

COM-B: Capability, Opportunity, Motivation to Behaviour Model

TDF: Theoretical Domains Framework

TA: Thematic Analysis

EE: Entertainment-education

OFGs: Online Focus Groups

TPB: Theory of Planned Behaviour

FBDGs: Food-Based Dietary Guidelines

GWG: Gestational Weight Gain

BMI: Body Mass Index

MRC Framework: Medical Research Council Framework for the development and evaluation of complex interventions

Chapter 1: Introduction

I was born and raised in Vietnam, where pregnant women face health care challenges during pregnancy, according to UNICEF (2021). I trained as a nutritional therapy practitioner in the United Kingdom before returning home to Vietnam where I worked as a lead nutritional practitioner at a maternity unit providing dietary consultations for pregnant women. Concerns about the lack of publicly available evidence-based nutrition information sources were frequently expressed by pregnant women during consultations. In the absence of such information, I noticed that they often relied on online sources or family and friends for advice, which can be potentially unreliable. Pregnant women may make decisions that could be harmful to their own health and the health of their unborn child as a result of biased and unreliable generic advice. This motivated me to form a non-profit organization to provide nutrition education support (i.e., nutrition classes or consultations) to pregnant women and mothers raising children under the age of five in Vietnam. I also started writing a Vietnamese language blog in 2016 about child and maternal nutrition on a Facebook page. Nearly 200,000 people now follow my page, with 85% of them being Vietnamese women aged 18-44 (see Appendix 1). It was apparent that the blog allowed me to reach a broader audience of women from different backgrounds. Through commending and answering women's questions, I learned about the challenges they face during pregnancy. In particular, I have observed that nutrition education alone is inadequate to help women make behaviour changes relating to healthy eating during pregnancy. Even though they are aware of the benefits, some women do always not follow the recommended regimen. I then wrote a Vietnamese-language book about maternal nutrition and challenges based on my own experiences and observations (Nguyen 2018). Aside from low access to nutritious foods and nutrition knowledge I found that, Vietnamese women's eating behaviour during pregnancy may be influenced by a variety of factors, such as their partners' attitudes, their families' attitudes, and their partners' families' beliefs regarding nutrition as well as food beliefs. This allowed me to recognise a need for evidence-based interventions that address the multiple factors that influence women's behaviours on healthy eating and weight gain during pregnancy for this population.

1.1 Rationale and aims of the thesis.

Undernutrition and inadequate gestational weight gain are linked to elevated chances of health problems for both mothers and their unborn babies, in both the short and long term (Kheirouri and Alizadeh 2021). Women who are undernourished during pregnancy are less likely to achieve sufficient energy and nutrients required for their own health and well-being,

as well as for the development of their foetus; consequently, they become more susceptible to infection and are at a higher risk for miscarriages, preterm births, and maternal mortality (Black et al. 2008; Mate et al. 2021). Furthermore, the nutritional status of pregnant women is directly related to intrauterine growth retardation of infants (Lechtig 1975; Wu et al. 2004; Imdad et al. 2012). It has been found that maternal undernutrition increases the risk of foetal growth restriction for about 32 million infants (excluding premature babies) in low-income and middle-income countries, which increases the risk of neonatal deaths and stunting by age two (Lee et al. 2017). Studies have shown that inadequate gestational weight gain, regardless of prenatal body mass index (BMI), is linked to an increased chance of delivery of a low-birth-weight infant and an adverse effect on pregnancy outcome (McDonald 2010; da Fonseca 2012). Notably, women who have low prenatal BMI ($<18.5 \text{ kg/m}^2$) at the beginning of pregnancy are likely to gain insufficient weight during pregnancy and have a higher small-for-gestational-age birth risk (Salihu et al. 2021).

In addition, pregnant women, especially those in developing countries, can suffer from micronutrient deficiencies (Gernand et al. 2016; Walle et al. 2020). Micronutrient deficiency in pregnancy occurs when there is an insufficient supply of essential vitamins and minerals required for healthy foetal growth and development. This can result from inadequate dietary intake, poor absorption, or increased nutrient requirements. This can threaten their health and wellbeing as well as the development and long-term health of the offspring (Christian and Stewart 2010). For example, it is globally estimated that between 34.0% and 39.1% of all pregnant women suffer from anaemia due to iron deficiency (IDA); the highest prevalence of IDA happens in low- and middle-income countries (WHO 2021). Based on the WHO Multicounty Survey, an analysis of about 300,000 pregnancies in 29 countries showed that severe IDA in pregnancy is associated with a two-fold increase in maternal mortality (Balarajan et al. 2011). Additionally, maternal IDA may lead to adverse birth outcomes such as low birth weight and increased perinatal mortality (Allen 2001; Christian and Stewart 2010). Furthermore, zinc is also a vital micronutrient in pregnancy that is involved in a variety of biological functions, such as the metabolism of nucleic acids, the synthesis of proteins, and the division of cells, (Chaffee & King 2012). Research suggests that zinc deficiency during pregnancy can lead to preterm and prolonged labour, postpartum haemorrhage, and limited growth in the foetus (Carducci et al. 2021). There is also mounting evidence that micronutrient deficiencies, such as zinc, magnesium, iron, copper, vitamin A, and vitamin E, during foetal development may cause alterations in kidney, pancreatic, and

vasculature structure that may result in cardiometabolic diseases in later life in offspring (Christian and Stewart 2010; Szostak-Wegierek 2014).

Vietnam held the third position in Southeast Asia and ranked fifteenth globally in terms of population, with approximately 96.2 million people in 2019. About one-third of the population in this country are women of reproductive age (15-49) (Central Population and Housing Census Steering Committee 2019). Like some lower-middle-income countries, undernutrition, inadequate weight gain and micronutrient deficiency during pregnancy remain major public health issues in Vietnam (Nguyen et al. 2019; Tran et al. 2019). It has been reported that 50 percent of Vietnamese women during pregnancy have inadequate intake of energy requirements as recommended by the Vietnam's Ministry of Health (Nguyen et al. 2018). Micronutrient deficiencies, including folic acid, iron, vitamin A, and calcium, were prevalent among these pregnant women. The national report released by the Ministry of Health (2018) reported that the prevalence of anaemia and zinc deficiency among pregnant women in Vietnam was 32.8% and 80.3%, respectively. Multiple studies, including Tu et al. (2014), Nguyen et al. (2018), and Tran et al. (2019), have consistently reported that pregnant women in Vietnam suffer from micronutrient deficiencies such as zinc, iron, vitamin A, and calcium, which can be linked to inadequate intake of nutrient-rich foods such as fruits, fish, milk, and eggs. Additionally, 30% of Vietnamese women start their pregnancy underweight and fail to gain the recommended amount of weight as recommended by the Institute of Medicine (Tran et al. 2019). Findings demonstrate that a low nutrition status and insufficient gestational weight gain can result in a higher risk of small for gestational age, low birth weight or premature birth in babies by up to 70% (Rahman et al. 2015; Liu et al. 2016), emphasizing the significance of proper nutrition and weight management during pregnancy.

Despite the scale and importance of this problem, very few interventions in Vietnam have been shown to have an effect. Interventions, to date, have been supplements or foods-based clinical trials (Nguyen et al. 2016; Nga et al. 2020). However, there is growing evidence that the problem may not only be related to the lack of availability of nutritious food (Kavle & Landry 2018; Martin et al. 2020). Limited nutrition knowledge can act as a driver of undernutrition among pregnant women. Women, who have limited knowledge of nutritional requirements as well as risks associated with unhealthy eating, were less likely to access nutritious foods and gain the recommended amount of gestational weight, according to the results from a community-based nutrition education initiative across 14 provinces in Vietnam (Tran et al. 2019). Notably, the dietary behaviour of pregnant women is also driven

by social and cultural systems (Bevelander et al. 2018). Studies in Southeast Asian countries demonstrated that women's choices about what to eat and what not to eat during pregnancy are affected by their cultural beliefs and food taboos, as well as the attitudes of their partners, their families, and their partners' families (World Bank 2019; UNICEF East Asia and Pacific Region 2021). Women's social status also plays a significant role in driving undernutrition because the low power status of women in some countries such as Cambodia, Myanmar, and the Philippines, can have a negative impact on the quality of health and nutritional care they receive and can provide to their unborn children (World Food Programme 2017; Myanmar Ministry of Health and Sport and ICF 2017; The Philippines Statistics Authority 2017). In these countries, fewer than half of the women reported making their own healthcare decisions, which means they may not be able to decide when and where to seek care, including antenatal care. However, there is little information about Vietnamese women relating to healthy eating and weight gain behaviours during pregnancy has been reported. Therefore, to facilitate the development of evidence-based behavioural interventions for improving maternal nutrition in this population, a better understanding of healthy eating and weight gain during pregnancy in this population is urgently needed.

Behaviour changes interventions alone or combined with education interventions have shown effects in managing gestational weight gain, raising women's awareness about the importance of nutritious diets, and improving the dietary diversity of pregnant women in Malawi (Ziyenda Katenga-Kaunda 2020) and some Southeast Asian countries (UNICEF East Asia and Pacific Region 2021). However, to the best of my knowledge, there is still a lack of behavioural interventions for pregnant women in Vietnam (see Chapter 2). To improve the diet for pregnant women in Vietnam, an evidence-based intervention is needed that addresses the multiple factors that influence women's behaviours regarding healthy eating and weight gain during pregnancy.

This thesis describes the first stage of developing such an intervention. I used the Medical Research Council (MRC)'s guideline (Skivington et al. 2021) as a theoretically informed framework for developing a complex intervention. The MRC Framework (first introduced in 2000 and updated in 2006, 2008 and 2021) has been used successfully across health disciplines in both developed countries and developing countries for developing and evaluating complex interventions (Lakshman et al. 2014; Vousden et al. 2018; Bobrow et al. 2018; Dumont et al. 2020; Lewis et al. 2022). This suggests that this flexible, non-linear framework may be useful for the design of evidence-based behaviour interventions for pregnant women in Vietnam as well. As seen in Figure 1, the MRC's framework, which

consists of four stages including develop/identify intervention, feasibility, implementation, and evaluation (which is detailed in Chapter 3), informs my overall intervention.

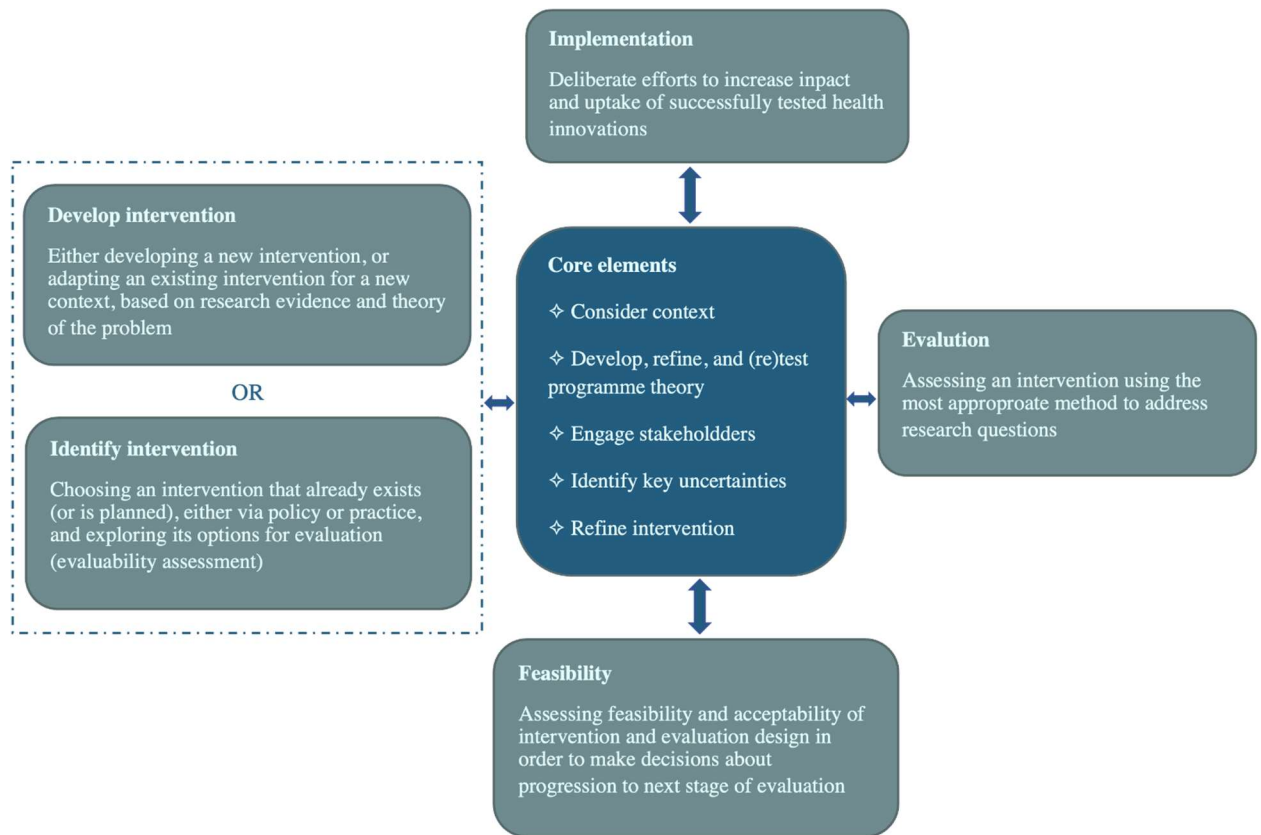


Figure 1: The 2021 MRC's framework for the development and evaluation of complex interventions (adapted from Skivington et al. 2021, p.4)

This thesis is an intervention development study guided by the overarching MRC framework; This thesis aims to build the evidence base for the developmental stage of the MRC framework including collecting information on the problem related to Vietnamese women's behaviours regarding healthy eating and weight gain during pregnancy as well as the theories underpinning the problem. Following completion of my thesis, I would aim to undertake the next stages in development, testing and implementation of the intervention.

Therefore, as an intervention development study, this thesis has two aims, as described below.

- **Aim 1:** To explore barriers and motivators toward healthy eating and weight gain behaviours during pregnancy among Vietnamese women of mixed socioeconomic backgrounds.

- **Aim 2:** To develop a logic model that examines potentially feasible and efficient components for healthy eating and weight gain behaviour intervention among this population.

1.2 Organization of the thesis

As seen in Figure 2, this thesis consists of seven chapters, described below.

- **Chapter 1: Introduction.**

This chapter addresses rationale and overall aims for conducting this thesis, while it also outlines the complete structure of the thesis. It also describes the challenges and motivations to conduct this thesis during the pandemic.

- **Chapter 2: A literature review.**

This chapter provides evidence about the importance of healthy eating and weight gain during pregnancy in the mother and the foetus' health. Moreover, the chapter also outlines the background of Vietnam as well as the prevalence of malnutrition and inadequate weight gain among pregnant women in Vietnam. Notably, policies and guidelines about maternal nutrition as well as the availability of interventions in Vietnam have been documented in this chapter.

- **Chapter 3: Aims and research questions, and methodology.**

This chapter presents the aims of this thesis along with research questions. Additionally, it provides the rationale for using the qualitative approach, using focus group interviews as a data collection method, and applying thematic analysis informed by the theoretical domains framework (TDF) and the Capability, Opportunity, Motivation to Behaviour (COM-B) model. Then, this chapter also gives in detail about the study design, including the process of research participant recruitment, the data collection, and the data analysis. Finally, ethical considerations and reflexivity are also found in this chapter.

- **Chapter 4: Findings of focus group interviews with pregnant women in Vietnam.**

This chapter explores 22 themes and subthemes identified from five focus group interviews. All themes and subthemes have been mapped into the COM-B model and the TDF domains.

- **Chapter 5: Discussion of the findings from the focus group interviews.**

This chapter discusses the findings from the focus group interviews with Vietnamese pregnant women.

- **Chapter 6: A logic model for evidence-based intervention.**

This chapter presents a logic model for the development of intervention targeting healthy eating and gestational weight gain behaviour among Vietnamese pregnant women in the future, based on the findings from the focus group interviews.

- **Chapter 7: Conclusion**

In this chapter, the study's conclusions, along with its strengths and limitations, have been presented. In addition, it highlights future research directions and implications for clinical practice.

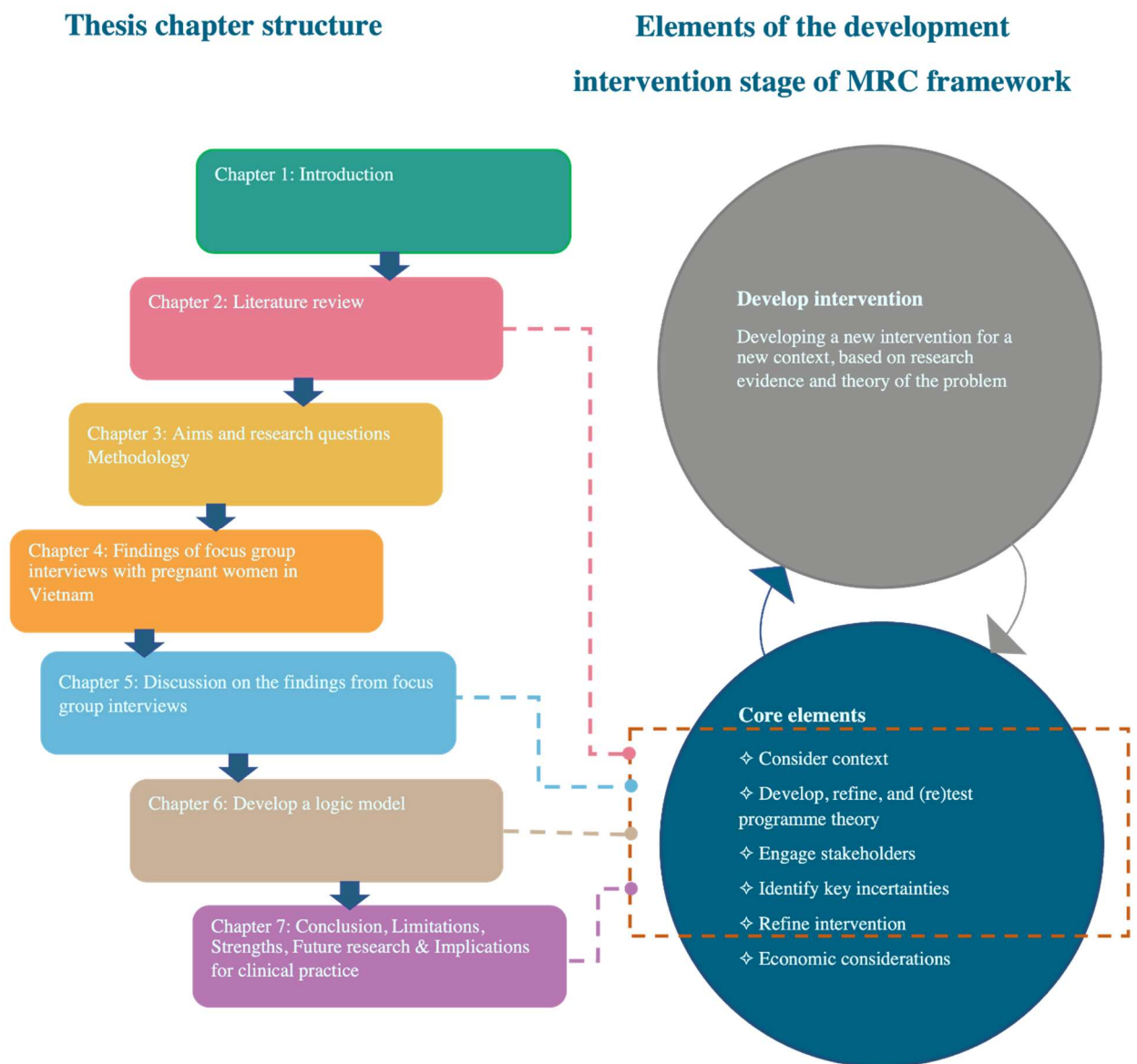


Figure 2: The flowchart of the thesis chapters (This thesis addressed key elements of the development intervention based on the MRC framework)

1.3 Impacts of the COVID-19 pandemic on the thesis

The COVID-19 pandemic originated in Wuhan, China in December 2019 and rapidly spread to the rest of the world just a few months later. Due to the travel restrictions to stop spreading the virus, communication in almost all countries in the world including the UK had to move into the virtual world where my research supervision entirely occurred on Teams, an online video chat platform. During this period, I was based and conducted my research activities in Vietnam, which involved the organization and execution of online focus group interviews with pregnant women, as well as the transcription and translation of data. My supervisors regularly met me on Teams with huge support and encouragement. However, I felt somewhat alone for this reason. This could be explained in that the pandemic brought me into a world I had never seen before. All schools and businesses had to be closed. Moreover, people were not allowed to go out for a free walk, catch up with friends and colleagues, or visit family members. The government daily notified people about the number of deaths, which really concerned me a lot. Moreover, I define myself as an outgoing person who enjoys working together and discussing ideas with others, having the company of others while working has always been a great benefit to me. Over time, I learnt to overcome my feelings and adapt to the changes to balance life and research work. It was a part of my learning in my doctoral journey.

At the beginning of the pandemic, this thesis was in proposal form and had not yet been operationalized. The thesis strongly grew up throughout the pandemic. My research plan has not been changed much because of the pandemic. As planned it basically happened online from the recruitment of research participants (recognised as pregnant women in this thesis) to the data collection (focus group interviews). However, it was worth noting that the pandemic would have also potentially altered the lives of pregnant women, including interrupted work, increased risk of violence, stress, and anxiety, or missing out on antenatal care. Because of this, the process of the research participant recruitment and focus group interviews was delayed several times although all the research participants were committed to joining the study. The potential impact of the COVID-19 pandemic on research participants has been described in Chapter 7.

Chapter 2: Literature Review

Good nutrition refers to a well-rounded diet that includes all the vital nutrients at the appropriate amounts and proportions necessary for growth, health, and proper bodily function, as defined by the World Health Organization (WHO 2022). Poor nutrition, on the other hand, refers to a diet that is deficient in nutrients either due to insufficient intake of food or imbalances, or one that contains an excessive number of certain components (WHO, 2022). Both the mother and her unborn child benefit from good nutrition during pregnancy. A healthy diet throughout pregnancy offers dual benefits of lowering the risk of complications such as pre-eclampsia, preterm birth, gestational diabetes, as well as promoting the proper growth and development of the foetus (Li et al. 2021). As mentioned earlier in Chapter 1, undernutrition among pregnant women continues to be a public health issue in Vietnam (Laillou et al. 2012b; Tu et al. 2014; Young et al. 2017; Nguyen et al. 2018; Ministry of Health 2018; Tran et al. 2019). To identify research gaps and interventions aimed at promoting healthy eating behaviours during pregnancy for this population, a comprehensive literature review was conducted.

This chapter consists of three parts. A visual representation of all these parts is presented in Figure 3.

- **Part 1: Three common concepts of healthy eating behaviours during pregnancy.**

This part commences by acknowledging three common concepts of healthy eating behaviours during pregnancy from various global health organizations and societies. Then, it offers valuable insights into the significance of promoting these principles of healthy eating behaviours among pregnant women, aiming to enhance maternal and foetal health outcomes.

- **Part 2: Understanding Maternal Nutrition Issues in Vietnam.**

In this part, a comprehensive literature review was conducted on the topic of healthy eating behaviours during pregnancy in Vietnam, the country where the thesis is being carried out. The review includes an overview of existing maternal nutrition issues in this population. Additionally, it also provides an understanding of prenatal healthy eating behaviours in Vietnam by analysing national policies and guidelines related to healthy eating behaviours during pregnancy, reviewing previous research and interventions that aimed to improve maternal nutrition in this population.

- **Part 3: Factors influencing healthy eating behaviours during pregnancy.**

The third part identify factors that may affect healthy eating behaviours among pregnant women in Vietnam and other countries in the Southeast Asian region.

Taken together, this literature review provides a foundation for understanding the context in Vietnam where the study takes place, as well as informs the research questions and aims of the thesis (see Chapter 3).

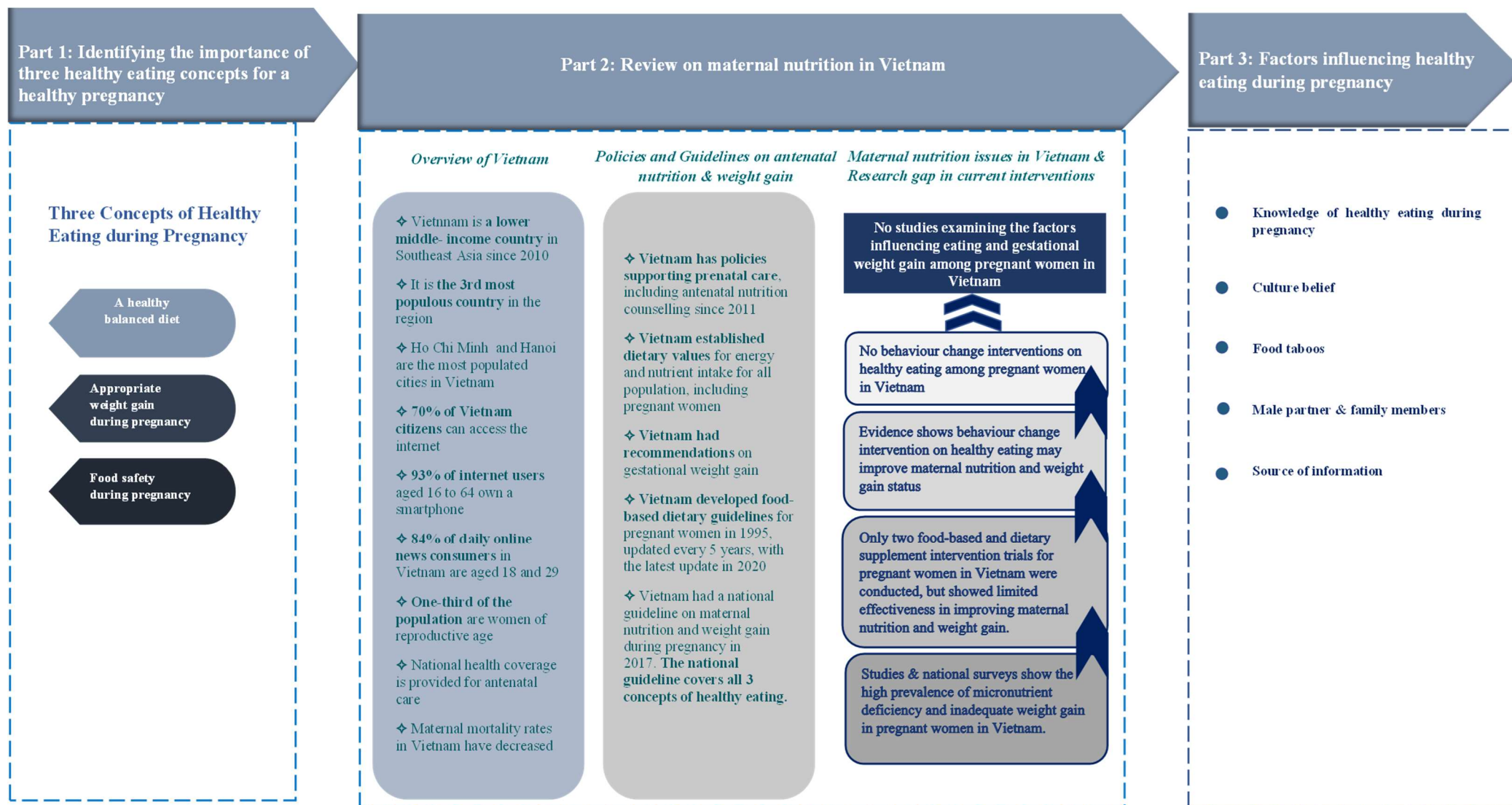


Figure 3: Overview of The Literature Review Chapter

The literature search plan

To explore the various aspects of the study's topic, a thorough search was conducted using a range of resources, including databases and websites. The areas of interest comprised concepts or interpretations of healthy eating during pregnancy, dietary behaviours, policies, and guidelines on maternal nutrition during pregnancy, nutrition knowledge, perceptions of healthy eating and weight gain during pregnancy, as well as motivations for and barriers to healthy eating behaviours during pregnancy. A comprehensive set of keywords and search terms were employed to retrieve and obtain the pertinent literature (see Appendix 5).

To ensure the acquisition of relevant scholarly literature, an extensive search was conducted across various databases, including Medline, Cochrane Database of Systematic Reviews, SCOPUS, PubMed, the Cumulative Index of Nursing and Allied Health Literature (CINAHL), and Vietnam's Medical Research Databases (for relevant studies in Vietnam). The search only included scholarly articles that were written in either English or Vietnamese and were available in full-text format.

In addition, I examined the official websites of international governmental authorities as well as Vietnam, carefully reviewing various documents accessible on these sites, including leaflets, fact sheets, brochures, and government reports. These sites were selected based on their relevance to the study's topic and were included as follows:

- The official websites of Vietnam governmental authorities, including the Vietnam Government Information Gateway, the Ministry of Health, the Department of Maternal and Child Health, the local Departments of Health, the National Institute of Nutrition, the Vietnam Nutrition Association, the Vietnamese Association of Midwives, and national-level maternity hospitals were consulted.
- The official websites of international governmental authorities, including the World Health Organization (WHO), the United Nations International Children's Emergency Fund (UNICEF), The Food and Agriculture Organization of the United Nations (FAO), as well as health organizations and societies specializing in maternal nutrition and health in Asia and the Southeast Asian region, and in developed countries such as the United Kingdom (UK) and the United States (US), were consulted.

Part 1: Three common concepts of healthy eating behaviours during pregnancy

Pregnancy is a critical period of life that is characterized by several physiological and metabolic changes in a woman's body, including changes in nutritional requirements. Healthy, balanced diets are crucial to a new-born's healthy development and a mother's physiological changes during pregnancy (Abu-Saad and Fraser 2010). However, poor nutrition during pregnancy has been associated with adverse maternal and foetal outcomes, such as neural tube defects, low birth weight, and preterm birth. Accumulative evidence demonstrating that the dietary patterns of mothers during pregnancy have an impact on the health outcomes of the mothers and their offspring both at birth and later in life (Li et al. 2021). For example, a meta-analysis conducted by Chia et al. (2019) examined the relationship between dietary patterns and birth outcomes, specifically birth weight and preterm birth. This meta-analysis found that healthy dietary patterns were linked to a reduced risk of preterm birth, while unhealthy dietary patterns were positively correlated with lower birth weight and an increased risk of prematurity. The healthy dietary pattern included whole grains, vegetables, fruits, and lean protein foods, while the unhealthy dietary pattern included the consumption of refined grains, processed meat, as well as sources of sugar and saturated fat. Similarly, a systematic review by Donovan et al. (2020) also found that consuming foods that are low in processed meats and sugars while high in fibre can have a positive impact on gestational weight gain in women. However, it is worth noting that both the systematic review and the meta-analysis consisted only of observational studies, which means that they were not able to establish cause-and-effect relationships. As a result, any conclusions that can be drawn from these studies are, at best, correlational. In addition, consuming too little or too much of certain nutrients or dietary patterns during pregnancy can lead to significant issues (Brink et al. 2022). For instance, vitamin A is crucial for foetal ocular and bone development and supporting the immune system during pregnancy. However, excessive consumption of vitamin A-rich foods during the first trimester can lead to severe foetal developmental abnormalities (Bastos et al. 2019). Casas et al. (2020) found a strong association between excessive simple sugar intake during pregnancy and various complications such as preterm birth, excessive gestational weight gain, and gestational diabetes mellitus. Therefore, it is crucial for pregnant women to follow a well-balanced and nutritious diet to ensure optimal health outcomes for both the mother and the foetus.

To promote healthy eating during pregnancy, various global health organizations and societies including the World Health Organization (WHO), National Institute for Health and Care Excellence (NICE), Royal College of Obstetricians and Gynaecologists (RCOG),

Association of UK Dietitians (BDA), American College of Obstetricians and Gynaecologists (ACOG), Food and Drug Administration (FDA), the Institute of Medicine (IOM), and Australian Government Department of Health and Aged Care, have developed guidelines and recommendations for pregnant women to follow. The guidelines and recommendations on maternal nutrition during pregnancy are not limited to developed countries but extend to developing nations. These guidelines aim to improve the health of both the mother and the foetus by promoting healthy eating behaviours during pregnancy. These recommendations vary among different regions and countries, but fundamentally consist of three common concepts as follows (Institute of Medicine 2009; NICE 2014; WHO 2016; BDA 2020; FDA 2021; Australian Government Department of Health and Aged Care 2021; RCOG Patient Information Committee and the Royal College of Midwives 2022; Aoyama et al. 2022)

- First, it is recommended to maintain a healthy and balanced diet. This involves a diet rich in lean protein, vegetables, fruits, and whole grains, while minimizing the consumption of foods high in salts, sugars, and saturated fat. WHO and global health organizations and societies in almost countries emphasize the importance of a healthy and balanced diet during pregnancy as well as the importance of micronutrients such as folic acid, iron, calcium, and vitamin D during pregnancy. It is worth noting, however, that differences in nutritional status between countries can lead to different recommendations for specific micronutrients. For example, iron is often recommended for all pregnant women in developing countries where food supplies are limited. Nonetheless, promoting a healthy and balanced diet with a focus on adequate micronutrient intake is vital for ensuring optimal maternal and foetal health outcomes (Aoyama et al. 2022).
- Second, appropriate weight gain is crucial during pregnancy. Excessive weight gain can increase the chance of gestational diabetes, hypertension, and macrosomia, while inadequate weight gain can lead to low birth weight, preterm birth, and other complications. Various countries have developed guidelines with specific recommendations on gestational weight gain; however, these recommendations may vary. The IOM (2009) in the United States is a widely recognized authority on gestational weight gain guidelines, and their recommendations are adapted by many nations. The IOM guidelines provide a range of recommended weight gain based on prenatal-pregnancy body mass index (BMI). Some nations, including the UK, recognize the importance of using pre-pregnancy BMI as a reference point but still consider other factors when providing recommendations. Therefore, they do not

provide specific recommendations on weight gain but rather refer healthcare professionals for further advice on gestational weight gain. Despite variations in specific recommendations, there is a consensus among health societies that appropriate gestational weight gain is important for maternal and foetal health and should be tailored to the individual based on pre-pregnancy BMI.

- Third, food safety during pregnancy is also a crucial aspect of maternal and foetal health. There is a consensus among health organizations and societies for pregnant women to avoid certain foods and beverages that could cause foodborne illnesses or expose them and their developing foetus to harmful substances. The types of food to avoid are fish containing high levels of mercury, unpasteurized dairy products, and raw or undercooked meat, fish, poultry, or eggs. Proper food handling and preparation techniques are also crucial in preventing foodborne illness. However, specific recommendations and guidelines may vary across countries and regions based on local food safety standards and practices. For instance, while the FDA (2021) recommends that pregnant women consume different grains to reduce the potential risks associated with consuming high levels of arsenic from rice, this recommendation may not be applicable in regions such as Southeast Asia, where rice is a dietary staple (Aoyama et al. 2022). Taken together, there is a general agreement that food safety during pregnancy plays a crucial role in maintaining optimal health for both the mother and the developing foetus.

In the following sections from section 2.1 to section 2.3, this review aims to investigate the importance of these three concepts in promoting maternal and foetal health.

2.1 Importance of maintaining a healthy and balanced diet during pregnancy

Carrying a developing foetus, it is crucial for the mothers to remain a proper balance in energy and nutrients because their diet and nutrient stores are the only sources of nutrition for the foetus' growth and development. In pregnancy, maternal hormone secretions are modulated by the growing foetus, resulting in alterations in carbohydrate, fat, and protein utilisation. Increased fat deposition is associated with elevated progesterone levels that occur during pregnancy (Armistead et al. 2020). Mid-pregnancy is the time when fat accumulation is rapid, which ensures an energy reserve for late pregnancy and lactation. Furthermore, there is evidence that protein can be stored in early pregnancy and used by the growing foetus in the later stage of pregnancy (Williamson 2006). The developing foetus relies on a continuous supply of glucose and amino acids to support its growth. Moreover, the placenta produces a hormone called human chorionic somatomammotropin that has been associated with the

increase in the availability of glucose and amino acids for the foetus by encouraging maternal tissues to utilize lipids for energy production.

In addition, there is a greater requirement for the utilisation of micronutrients due to the dietary demands of a growing foetus. A systematic review and meta-analysis of ten longitudinal studies demonstrated that the plasma volume of pregnant women increased by 6%, 18%, and 42% in the first trimester, second trimester and the last trimester, respectively, in comparison with non-pregnant counterparts (Aguree and Gernand 2019). The analysis was based on data collected from mixed populations, but having predominantly Caucasian women, including Europe (the UK and Netherlands), North America (the US), South America (Bolivia) and Africa (Nigeria). During pregnancy, red cell mass also increases up to 250 ml (Williamson 2006). The expansion of both plasma volume and red blood cell mass is necessary to meet the growing demand for oxygen because the foetus develops, and the mother's reproductive organs undergo enlargement. This physiological adjustment is necessary to support the growing demands of both the mother and the developing foetus. This means that the iron requirement becomes greater during pregnancy because elemental iron is essential to carry oxygen. Iron deficiency-related anaemia may occur when women's dietary iron intake is inadequate during pregnancy. Most pregnant women in developing countries suffer from anaemia during pregnancy although this condition remains a global health issue in both developed and developing countries (Karami et al. 2022). Iron deficiency is commonly responsible for anaemia in pregnancy. Worldwide, 31.5 to 42.4% of pregnant women suffer from anaemia (Karami et al. 2022), while 19% suffer from iron deficiency (Black et al. 2013). A mother suffering from iron deficiency anaemia during pregnancy is more likely to deliver a preterm baby, deliver a child with a low birth weight, and deliver a baby who is small for her gestational age (Ren et al. 2007). It is noteworthy that low birth weight is a crucial indicator of healthy foetal growth (Bernstein et al. 2000), and new-borns with birth weight under the 10th centile face a higher risk of various health problems, including sudden infant death syndrome and neurological disorders (Brodsky 2004, Hunt 2007, Bamfo 2011, Markel 2014; Ismail 2012, Cosmi 2011, Longo 2013). Maternal iron deficiency also affects umbilical cord blood iron concentration and can impair auditory recognition memory in infants (de Sá 2015; Geng 2015). Iron deficiency in mothers may increase the chances of their children having learning and memory impairments later in life (Radlowski et al. 2013; Geng et al. 2015).

Folate (or folic acid), in addition to iron, is a key nutrient involved in the synthesis of DNA and the production of neurotransmitters, with a particularly critical role during embryonic

development. Adequate folate intake is crucial prior to conception and throughout the subsequent 28 days, as this period is fundamental for neural tube formation. A deficiency in folate is strongly correlated with elevated risk of neural tube defects (De-Regil 2010). The presence of a low maternal folate level is linked to a higher risk of new-borns being small for their gestational age and having low birth weight (van Uiter 2013).

It is also important for the development and growth of the foetus that the mother has sufficient vitamin B12. It has been shown that low levels of vitamin B12 in a foetus may result in low lean mass, insulin resistance, excessive body fat, and impaired neurodevelopment (Rush 2014). A low blood supply during delivery can lead to blood transfusions, preeclampsia, placental abruption, and cardiac failure (Achebe et al. 2017).

The dietary demands of a developing foetus may cause an increase in transitory bone mineral loss in women. Not all mothers' recover from this despite increased intestinal calcium absorption and increased calcium intake during pregnancy (Kalkwarf and Specker 2002). Moreover, insufficient calcium levels during pregnancy are correlated with the occurrence of pre-eclampsia and its associated complications. The Cochrane systematic review demonstrated that calcium supplementation was beneficial to prevent pre-eclampsia during pregnancy (Hofmeyr 2018). An updated recommendation from the World Health Organization (2020) also emphasised that calcium supplementation should be advised to women before or during early pregnancy. This would aid in reducing or preventing hypertension and other related complications during pregnancy in the absence of adequate dietary calcium intake.

In summary, consuming a balanced and varied diet that contains that offers adequate energy, essential macro, and micronutrients is beneficial in meeting the increased nutritional needs during pregnancy, as well as supporting healthy foetal growth and development. Adequate intake of nutrients such as protein, folate, iron, calcium, and vitamin B12 is particularly important during pregnancy, as deficiencies in these nutrients can lead to adverse outcomes such as preterm birth, maternal anaemia, and low birth weight.

2.2 Importance of achieving appropriate gestational weight gain

Gestational weight gain (GWG) plays a significant role in promoting favourable outcomes for both mothers and their infants. Insufficient weight gain during pregnancy raises the possibility of delivering a baby with low birth weight, while excessive weight gain increases the risk of preeclampsia and gestational diabetes (Nguyen 2019). Gestational weight gain is an important factor that is required to support increased metabolic demand, and to enhance

positive pregnancy outcomes (Raatikainen 2006). Achieving an appropriate gestational weight gain is crucial for achieving an optimal and well-balanced outcome for both the mother and her baby (Nguyen 2019). It supports the growth and development of the foetus and reduces the likelihood of morbidity and mortality (WHO 1995; Institute of Medicine 2009). On the other hand, excessive or insufficient weight gain during pregnancy can present health risks to both the mother and the foetus (Wen et al. 2015; Golawski et al. 2023). Rapid weight gain per week, such as gaining 0.5-1 kg within a week, is strongly linked to the life-threatening condition known as preeclampsia (Haugen 2014; Moll 2017). Moreover, excessive, or insufficient GWG can contribute to an increased risk of caesarean delivery, small or large gestational age, and other pregnancy complications, including preeclampsia and gestational diabetes mellitus (Nehring 2011; Kirkegaard 2014).

In conclusion, gestational weight gain is a crucial aspect of a healthy pregnancy that supports optimal outcomes for both the mother and her infant. Maintaining a desirable weight gain throughout pregnancy is of utmost importance to ensure healthy foetal growth and development, while simultaneously minimizing the risk of negative health consequences like preeclampsia and gestational diabetes. However, both excessive and insufficient weight gain can have negative consequences and increase the risk of complications during childbirth, including caesarean delivery and gestational diabetes mellitus. It is important for pregnant women to receive adequate prenatal care and guidance from healthcare providers to ensure a healthy weight gain throughout pregnancy. By doing so, they can promote positive pregnancy outcomes and ensure the best possible health for themselves and their babies.

2.3 Importance of diet safety during pregnancy

Women who are pregnant are more prone to infections because of hormonal changes, which decrease immunity (Abu-Raya et al. 2020). According to Mateus (2013), pregnant women face an increased susceptibility to infections, with a risk approximately 18 times greater than that of the general population. Furthermore, harmful foodborne bacteria can be transmitted through the placenta by the mother; the foetus lacks immunity competency to defend against them. Salmonella infection almost always causes fever and gastrointestinal symptoms such as nausea, vomiting, stomach cramping, and diarrhoea in pregnant women, but 4% of cases develop intrauterine sepsis (Tam et al. 2010). Additionally, listeriosis is most associated with pregnancy, accounting for 20.7% of the global cases, with a mortality rate of 14.9% (Maertens de Noordhout 2014). Symptoms such as fever, malaise, and myalgia are common in those who with listeriosis. Due to insufficient immune system functioning, listeriosis can have life-threatening consequences in embryos and infancy, including miscarriage,

premature birth, central nervous system infections, and septicaemia (Maertens de Noordhout 2014).

In addition, some harmful substances, such as alcohol and heavy metals, may cross the placenta through the umbilical cord and enter the foetus' bloodstream. Pregnancy complications and the foetus' growth disorders in relation to substance use have been well-documented in the literature, but the mechanisms remain unclear. Alcohol consumption during pregnancy can lead to the development of foetal alcohol spectrum disorders (FASDs) and potentially increase the chances of miscarriage and stillbirth (Bailey 2011). Children affected by FASDs may experience a variety of challenges, including intellectual and developmental disabilities, later in life (Moore et al. 2015). Moreover, there is growing evidence that alcohol can aggravate micronutrient deficit among drinking pregnant women (Allen 2005; Naik et al. 2022).

Heavy metals such as cadmium, mercury, lead, and arsenic can accumulate in foetal tissues as they can cross the placenta. This makes children vulnerable to metal exposure, even during the early stages of gestation. Research has demonstrated that prenatal exposure to these heavy metals is linked to low birth weight, which increases the chance of sudden infant death syndrome and premature birth (Clarkson 1985, Kampa 2008, Hanna 2012, Wai et al. 2017). In addition, case-control studies conducted in China indicate a strong association between prenatal exposure to toxic metals, such as mercury, lead, and titanium, and coronary heart disease in infants (Sun et al. 2022; Wang et al. 2022).

In summary, pregnant women are more susceptible to infections due to hormonal changes that reduce immunity. Harmful foodborne bacteria and substances such as alcohol and heavy metals can cross the placenta and pose significant risks to the foetus. Consumption of alcohol during pregnancy can result in foetal alcohol spectrum disorders, which can have serious developmental consequences in later life. Exposure to heavy metals like Cadmium, mercury, lead, and arsenic during pregnancy is linked to reduced birth weight, which increases the risk of various health problems, including prematurity and sudden infant death syndrome. Therefore, it is crucial to educate pregnant women about the risks associated with infections, alcohol, and exposure to heavy metals and to take steps to mitigate these risks to ensure a healthy pregnancy and foetal development.

Part 2: Understanding maternal nutrition issues in Vietnam.

The previous sections underscore the significance of adhering to healthy eating behaviours during pregnancy, with three concepts identified as essential factors for promoting the

wellbeing of both the mother and the developing foetus. This section provides a review of Vietnam's maternal nutrition policies and guidelines and discusses current issues and challenges in related to the nutrition status of pregnant women in the country, as well as existing interventions aimed at addressing these issues.

2.6 Overview of Vietnam

2.6.1 Socio-Demographic Overview of Vietnam

Vietnam is a long, narrow nation that resembles the letter 'S' (see Figure 4). Positioned in Southeast Asia, the country lies on the eastern border of Indochina. It shares its northern boundary with China, while Laos and Cambodia are situated to the west. According to the result of the latest Population and Housing Census in 2019, the total population of Vietnam is 96.2 million people (Central Population and Housing Census Steering Committee 2019). The population of Vietnam ranks as the third-largest nation in Southeast Asia and holds the fifteenth biggest in the world. The population is projected to experience a 12% growth, reaching approximately 103 million people by 2030. Among them, 25 million (25%) will be women of reproductive age (WRA). Presently, nearly 35% of the population resides in urban areas, with this proportion estimated to rise to 40% by 2030. Hanoi and Ho Chi Minh are Vietnam's most populous cities with 2,398 persons per square kilometre and 4,363 persons per square kilometre, respectively.

Vietnam underwent a drastic transformation in the past three decades, transitioning from one of the world's poorest nations in the mid-1980s with gross domestic product (GDP) per capita at \$200-\$300, to a thriving middle-income economy with a GDP per capita of almost \$3,700 as of 2021, thanks to the series of economic and political reforms launched under "Đổi Mới" in 1986. With a GDP annual growth rate averaging 6.27% from 2000 to 2022, Vietnam is now one of the fastest-growing economies in Asia (Nguyen et al. 2022). The poverty rate has dramatically decreased from 14% in 2010 to 3.8% in 2020. Furthermore, nearly the entire population (100%) had access to electricity in 2020, up from a mere 14% in 1993, and about 74% of Vietnamese citizens can now access the internet thanks to the development of information services, with 93% of all users aged 16 to 64 owning a smartphone (AlphaBeta, 2021; Ministry of Information and Communications 2022). The Pew Research Center's study in 2018 found that while people in developing countries are less likely to get daily news online, Vietnam is an exception, with most individuals between 18 and 29, regardless of gender and income, receiving daily information online. This age group accounts for 84% of daily online news consumers in Vietnam (Pew Research Center, 2018).

In recent decades, family structures in Vietnam have experienced notable transformations, with nuclear families increasingly prevalent, especially in urban areas (Central Population and Housing Census Steering Committee 2019). According to the latest census data, the average household size has substantially decreased from 4.82 individuals in 1989 to 3.6 in 2019. In 1989, there was little difference in household size between rural (4.80 persons) and urban areas (4.83 persons), but urban areas have since experienced a more rapid decline, resulting in an average household size of 3.40 persons in urban areas and 3.60 persons in rural areas by 2019. Nonetheless, Vietnamese families still maintain close relationships with one another, particularly during major life events, such as pregnancy and childbirth (Nguyen, 2015), with elder women in the family serving as advisors for younger women during these times. The Vietnamese culture places a strong emphasis on respect for elders, particularly grandparents and parents (Van, 2013).



Figure 4: Map of Vietnam (excerpted from ASEAN UP)

2.6.2 Healthcare System and Reproductive health in Vietnam

Vietnam's healthcare system comprises a blend of public and private sectors, with public hospitals serving as the primary providers of healthcare services to the populace. The public sector controls around 78.2% of hospitals in Vietnam, playing a pivotal role in ensuring the efficiency and cost management of healthcare services (Vietnam Ministry of Health 2018).

Vietnam's healthcare system is organized into four tiers based on administrative structure: central (Level I), provincial (Level II) serving 1-2 million people, district (Level III) covering 100,000-200,000 people, and commune (Level IV) catering to approximately 5,000-10,000 residents (Le et al. 2010; Takashima et al. 2017). According to Vietnam Ministry of Health (2020), there are 47 central hospitals (Level I), including 20 national general medicine hospitals, 3 traditional medicine hospitals, 3 leprosarium, 1 sanatorium and rehabilitation centre, and 20 specialized hospitals, including obstetrics and gynaecology. At Levels II, III, and IV, there are 470 provincial health facilities, 947 district health facilities, and 11,100 communal health stations, respectively (Vietnam Ministry of Health 2020). These levels align with Vietnam's administrative divisions, consisting of 63 provinces, 592 districts, and 8,801 communes. High-level hospitals offer a broader range of healthcare services, particularly those requiring advanced technical skills, compared to lower-level medical facilities.

Private hospitals have seen substantial growth, increasing from 155 to 288 units between 2015 and 2018 (Ministry of Health in 2018; Le et al. in 2020). Nearly half of these private hospitals are located in major metropolitan cities: Hanoi, Da Nang, Ho Chi Minh, Hai Phong, and Can Tho. Approximately 79% of all provinces (50 out of 63) have at least one private hospital, with an average of 1.7 beds per 10,000 individuals (Sang et al. 2020). In comparison to public healthcare facilities, private hospitals cater to the expectations of the middle-income classes by offering advantages such as shorter waiting times, enhanced amenities, more patient-friendly interactions with providers, and improved consultation services (Sang et al. 2020, p.5).

Maternity care services are accessible at all levels, including commune, district, provincial, and central health facilities in both the public and private sectors (Nguyen et al. 2018). Nearly 90.7% of pregnant women attend a minimum of three antenatal care visits (Vietnam Ministry of Health 2018). While midwives are available in nearly all hospitals and community health stations, physicians are the primary providers of antenatal care, and most births occur in hospitals with physician assistance (UNICEF 2020b).

Vietnam has witnessed a significant increase in social health insurance (SHI) coverage, rising from 5% to 89% of the population between 1993 and 2018 (Vuong et al. 2021; WHO 2020). As per the revised Health Insurance Law No 46/2014/QH13 since 2014, SHI co-payments are structured with 0% for vulnerable groups, including children under 6, the poor, ethnic minorities, and individuals serving in the army and the police; 5% for the near-poor; and 20% for all others (Nguyen 2020). This configuration allows SHI to cover health costs ranging from 80% to 100%. To fully benefit from SHI coverage, individuals must either visit the healthcare facility registered as their primary care provider on their SHI card or receive a referral to a higher-level hospital from their primary care facility. In maternal care, SHI covers public pregnancy and delivery care costs at lower-level healthcare facilities or higher-level hospitals with referrals in cases of pregnancy and childbirth complications (National Assembly Vietnam 2008). These services within the public system are offered to women free of charge.

Despite SHI coverage, out-of-pocket (OOP) payments, which involve direct payments, remain high for various reasons. Many public hospitals, especially at the provincial and central levels, offer both public and private services since the implementation of the financial autonomy policy in public hospitals (Vietnam Government 2015; Do et al. 2018). The coexistence of private healthcare alongside public services can contribute to increased OOP expenditures (Nguyen and Willson 2017; Ha et al. 2021). Moreover, due to the perception of superior healthcare quality and access to advanced technology in higher-level and private hospitals, many urban pregnant women opt to pay out of pocket for direct access to these facilities (Ngo and Hill 2011).

2.7 A comparative review of antenatal nutrition and gestational weight gain guidelines and policies in Vietnam and worldwide

This section provides an overview of the guidelines and policies related to prenatal dietary supplementation, gestational weight gain, and dietary recommendations during pregnancy, in Vietnam in comparison to global standards.

Guideline on prenatal vitamin and dietary supplementation

Antenatal care (ANC), also known as prenatal care, first came to be a public health issue in the late 1930s in Great Britain and then rapidly recognised by other developed countries (Banta 2003). According to WHO, the primary purpose of ANC is to provide medical services, antenatal nutrition care and other care during pregnancy to ensure healthier birth outcomes and reduce foetal and infant mortality as well as maintain women's health (Banta

2003). WHO (2007) released the Standards for Maternal and Neonatal Care, which provided comprehensive advice on good practices for a healthy pregnancy including advice on maternal nutrition. Of the WHO (2007)'s standards, it emphasized the role of folate and iron as well as the supplementation of these nutrients during pregnancy to prevent anaemia and neural tube defects, respectively. A more recent guideline of WHO (2016) established 49 essential recommendations on routine antenatal care for pregnant women and adolescent girls to remain a positive and healthy pregnancy. Nearly one third (14) of these recommendations focused on nutrition. According to the WHO's recommendations on micronutrient supplementation, it is advised that pregnant women consume daily elemental iron (30-60 mg) and folic acid (0.4 mg) to mitigate the risk of maternal anaemia. In populations with inadequate daily intake and a high prevalence of night blindness, calcium supplementation (1.5-2 g daily) and vitamin A (up to 10,000 IU vitamin A daily or up to 25,000 IU vitamin A weekly) are advised (WHO 2016). Calcium supplementation is also advised prior to pregnancy to mitigate the risk of pre-eclampsia and its associated complications.

Vietnam aligns with the WHO recommendations by advising all pregnant women to take iron and folic acid supplements. The recommended daily dose of iron for pregnant women in Vietnam is 60 mg, while the recommended daily dose of folic acid is 400 µg (Vietnam Ministry of Health 2017). It is important for pregnant women to continue taking these supplements until 1 month after childbirth as they help to prevent anaemia and other health complications for both the mother and the baby. It is also recommended that Vietnamese women to obtain calcium from dietary sources, particularly from milk, to meet the daily requirement of 1200mg starting from the second trimester. Multi-micronutrient supplements may also be recommended for pregnant women in Vietnam, particularly if they are at risk of malnutrition or have a limited diet. These supplements contain a combination of vitamins and minerals, including iron, folic acid, and calcium.

Guideline on weight gain during pregnancy

Pregnancy can cause notable weight changes in women's bodies. It's expected for women to gain more weight in the latter two trimesters as it supports the foetus's growth, placental development, and amniotic fluid. Nonetheless, gaining too much or too little weight during pregnancy can lead to negative consequences such as increased risk of caesarean delivery, small or large gestational age, and other adverse pregnancy outcomes, including gestational diabetes mellitus and preeclampsia (Nguyen 2019). WHO defined body mass index (BMI) as "a person's weight in kilograms divided by the square of the person's height in meters

(kg/m²)” (WHO 2010). BMI is widely acknowledged as an effective measure for identifying overweight individuals and assessing associated health risks. As BMI increases from overweight to extreme obesity, the likelihood of experiencing health issues also tends to rise (Nguyen 2019). The recommendations provided by the American Institute of Medicine (IOM) regarding optimal weight gain during pregnancy are based on WHO-BMI ranges, which encompass various categories from underweight to obesity. It is important to note, however, that these recommendations do not specifically address all classes of obesity, as outlined in Table 1.

Table 1: Recommendation of gestational weight gain based on the 2009 Institute of Medicine guideline.

Recommendations	Underweight	Normal weight	Overweight	Obese
Prenatal BMI (kg/m ²)	<18.5	18.5–24.9	25.0–29.9	≥30
Total weight gain range (kg)	12.5–18	11.5–16	7–11.5	5–9

While being widely applied in many countries, it is noteworthy that the recommendations of the Institute of Medicine (IOM) on gestational weight gain (GWG) originated solely from American population-based studies (Alavi et al. 2013). The applicability of the IOM's recommendations for Asian women to achieve their desired GWG is limited, as observed in studies conducted on Asian populations. Cumulative evidence has revealed that Asian adults tend to accumulate more body fat and have a higher risk of diabetes and cardiovascular diseases at lower BMI levels compared to non-Asians (Nguyen 2019). Consequently, the panel of WHO consultation developed regional BMI cut-off points for Asians to minimize these risks (see Table 2). According to a meta-analysis involving more than 300,000 Asian women, it was found that the GWG recommendations provided by the IOM are more applicable when regional BMI cut-off points for overweight or obese individuals are utilized (Goldstein et al. 2018). However, it is important to note that the study's findings are not representative of all Asian women, as it primarily focused on pregnant women in Korea, China, Japan, and Taiwan. Notably, Korean, and Taiwanese women tend to experience greater weight gain during pregnancy compared to other Asian women (Cheng et al. 2011). This underscores the need for further comparative studies across Asia.

To date, due to no global consensus regarding the desired GWG for Asians, many Asian countries including Vietnam have adapted the IOM's guideline on GWG to be specific to the Vietnamese population (Japan Society for the Study of Obesity 2016, Nguyen 2019). National Guidelines on Nutrition for Pregnant Women and Breastfeeding Mothers (Vietnam Ministry of Health 2017) recommended that pregnant women with normal prenatal BMI (18.5-24.9 kg/m²) should gain 10-12 kilos throughout the pregnancy: 1 kilo for the first trimester, 4-5 kilos for the second trimester, and 5-6 kilos for the last trimester. Pregnant women with low prenatal BMI (<18.5 kg/m²) should gain 25% of prenatal weight during pregnancy while those who with large prenatal-BMI (≥25 kg/m²) are advised to gain 15% of prenatal weight during pregnancy.

Table 2: Asian cut-off points BMI (kg/m²) according to WHO guidelines (adapted from Lim et al. 2017)

	Asian cut-off points BMI (kg/m ²)	WHO (BMI) (kg/m ²)
Underweight	<18.5	<18.5
Normal weight	18.5–22.9	18.5–24.9
Overweight	23–24.5	25–29.9
Obese	≥25	≥30

Guidelines and Policies on dietary recommendations during pregnancy

Food-based dietary guidelines (FBDGs), also known as dietary guidelines, also play an important role in a certain population to maintain its well-being and prevent diet-related medical conditions or nutrient deficiencies in this population. During pregnancy, women do require the proper nutritional needs not only for themselves, but also for the growth and development of the foetus. Therefore, the International Children's Emergency Fund (UNICEF) of the United Nations and the Food and Agricultural Organization (FAO) have been promoting the development of food-based dietary guidelines (FBDGs) targeted to vulnerable populations including children, pregnant and lactating women. To facilitate the development of FBDGs, dietary values such as the estimated average requirement (EAR) and recommended nutrient intake (RNI) were set as targets for human nutrient intake. WHO and the Food and Agricultural Organization (FAO) of the United Nations defined EAR as “the average daily nutrient intake level that meets the needs of 50% of the “healthy”

individuals in a particular age and gender group” while RNI is “the daily intake, set at the EAR plus 2 standard deviations (SD), which meets the nutrient requirements of almost all apparently healthy individuals in an age- and sex-specific population group.” (WHO & FAO 2004, p. 2). Similarly, developed countries set values for their specific populations. For example, the United Kingdom (UK) sets up four types of Dietary Reference Values (DRVs) including the EAR, RNI, Lower Reference Nutrient Intakes (LRNIs), and Safe Intake. In the terms of RNIs and LRNIs, the UK Department of Health (1991, p.5) defined RNI as “the amount of a nutrient that is enough to ensure that the needs of nearly all a group (97.5%) are being met while LRNIs is the amount of a nutrient that is enough for only a small number of people in a group who have low requirements (2.5%)”. Where evidence on EARs, RNIs and LRNIs is not available, safe intake is used to be adequate for almost everyone's needs but not so large as to result in undesirable effects (UK Department of Health 1991, p.5).

In Vietnam, the Ministry of Health also granted official approval to the Recommended Dietary Allowances (RDA) for energy and specific nutrients in 1996, establishing them as the recognized guidelines for nutritional requirements in the country. A revised version of RDA for the Vietnamese has been developed in 2007 and updated in 2016. To date, this updated RDA is an essential evidence-based tool for evaluating nutritional adequacy, as well as for educational and scientific purposes within Vietnam (Khan 2008, National Institute of Nutrition 2016). Besides, Vietnam among 92 countries in the world, as reported by UNICEF (2020a), have FBDGs. Vietnam has advanced policies on antenatal nutrition, particularly promoting nutrition counselling and preventing micronutrient deficiency during pregnancy (see Table 4). The Vietnamese Food-Based Dietary Guidelines (FBDGs) were initially published in 1995 and have undergone revisions every five years. The objective of these guidelines is to promote healthy eating habits and provide a foundation for shaping food and agriculture policies (Hop et al. 2011; FAO 2022). The most recent version of the Vietnamese FBDGs, spanning from 2016 to 2020, caters to different population groups, including adults, children, and pregnant or lactating individuals (National Institute of Nutrition 2016; FAO 2022). The Vietnamese FBDGs for the pregnant and breastfeeding women are represented as a food pyramid (see Appendix 2). Additionally, National Guidelines on Nutrition for Pregnant Women and Breastfeeding Mothers has been developed as the latest version of the dietary guidelines in 2017 (Vietnam Ministry of Health 2017). This 85-page guideline did focus on information about nutrition and weight gain for pregnant and lactating women. This guideline has been developed based on the Vietnamese recommendations for dietary allowances (Khan 2008; National Institute of Nutrition 2016), as well as the Ten tips for

proper nutrition in Vietnam 2011–2020 (FAO 2022). It also adopted international nutrition and physical activity guidelines (Hop et al. 2016) to the findings of nutrition and health studies across the country. The national guidelines for pregnant women, as presented in Table 3, address all three key components of healthy dietary behaviours during pregnancy, as discussed in Part 1. Specifically, these recommendations include guidance on healthy eating patterns, the significance of key nutrients during pregnancy, as well as dietary and vitamin supplementation, adherence to food safety measures, avoidance of certain foods, and management of weight gain during pregnancy.

Table 3: The national guideline for pregnant women in accordance with three concepts of healthy eating

Three Concepts of Healthy Eating during Pregnancy		National Guidelines on Nutrition for Pregnant Women & Breastfeeding Mother (*)	
		Yes/No	Details
A healthy balanced diet	Provide recommendations for healthy eating and the types of foods that should be included in the diet during pregnancy.	Yes	▪ Promoting a balanced diet ▪ Increasing the intake of fruits, vegetables. ▪ limiting high-fat, high-sugar, and high-sodium foods. ▪ Providing tailored advice on healthy eating for each trimester ▪ Providing general advice on healthy eating, the food sources and benefits of specific micronutrients such as calcium, iron, zinc, vitamin D, vitamin C, and Iodine
	Provide information about additional energy intake during pregnancy	Yes	Add 50 kcal in the first trimester. Add 250 kcal in the second trimester. Add 450 kcal in the third trimester.

	Provide information about supplements to take during pregnancy	Yes	For all pregnancy: iron (60 mg) and folic acid (400 µg) every day through pregnancy until 1 month after childbirth, or multi-micronutrients, as required
Appropriate gestational weight gain	Recommendation based on prenatal-BMI	Yes	Classify prenatal-BMI as ▪ Underweight (<18.5 kg/m²) ▪ Normal (18.5-24.9 kg/m²) ▪ Overweight (>25 kg/m²)
	Provide information about specific weight gain during pregnancy	Yes	▪ Gain at least 15% of pre-pregnancy weight if prenatal BMI <18.5 kg/m² ▪ Gain 10-12 kg if normal prenatal BMI. ▪ Gain at least 15% of pre-pregnancy weight if prenatal BMI >25 kg/m²
Food Safety during pregnancy	Provide information about food safety during pregnancy	Yes	▪ Avoid consuming raw or uncooked foods. ▪ Do practice good food hygiene habits.
	Provide information about food to avoid or limit during pregnancy	Yes	▪ Limit alcohol, beer, coffee, and dark tea. ▪ Limit spices such as chili, black pepper, and garlic
(*) The guideline encompasses recommendations for both pregnant women and breastfeeding mothers; however, the table here solely portrays the guidelines for pregnant women due to the thesis' scope.			

Besides policies and guidelines on antenatal nutrition, nutrition education is a crucial component of routine antenatal care, as recommended by the WHO and adapted to Vietnam's national guidelines for reproductive healthcare (WHO 2018). In low- and middle-income countries like Vietnam, antenatal nutrition education is deemed a suitable intervention for improving maternal nutrition (Bhutta 2013; Vaivada 2017; Kavle et al. 2018). Various studies have demonstrated the positive impact of nutrition education on the nutritional awareness and nutrient intake of pregnant women (Zangi 2014; Ota et al. 2015). Furthermore, research has established a significant association between nutrition education and improved pregnancy outcomes (Garg and Kashyap 2006; Everette 2009; Nehring et al. 2011).

Table 4: Major policies affecting antenatal nutrition in Vietnam

Policy code	Policy name	Strategy or plan for antenatal nutrition mentioned in policy	
		Antenatal nutrition counselling	Micronutrient for antenatal nutrition
Prime Ministerial Decision No.21/2001/QD-TTg (Prime Minister 2001)	The national strategy on nutrition for the period 2001-2010	No yet	Yes

Prime Ministerial Decision No. 226/QĐ-TTg	The national nutrition strategy for the 2011-2020 period, with a vision toward 2030	Yes	Yes
Prime Ministerial Decision No. 02/QĐ-TTg (Prime Minister 2022)	The national nutrition strategy for the 2021-2030 period, with a vision toward 2045	Yes	Yes
Prime Ministerial Decision No.1896/QĐ-TTg (Prime Minister 2019)	Promulgating program for nutrition care in the first 1.000 days of life for prevention of maternal and child undernutrition and improvement of Vietnamese people's height.	Yes	Yes
Ministry of Health Decision No.718/QĐ-BYT (Ministry of Health 2018)	Approving national action plan for nutrition by 2020	Yes	Yes
Ministry of Health Decision No. 4976/QĐ-BYT (Ministry of Health 2020)	Approving launching the “Nutrition-balanced Menu Development Software used for pregnant women, breastfeeding mothers & children aged 7 months to 60 months”, to be used at health organizations nationwide, including private health organizations,	Yes	Yes

2.8 The existing challenges in maternal nutrition in Vietnam.

Maternal nutrition challenges in Vietnam

The government of Vietnam has made significant progress in developing guidance and policies on maternal nutrition (see Section 2.7), but deficiencies of macro- and micronutrients in adults and women of reproductive age (WRA) are still a public health issue (Hoang et al. 2009; Laillou et al. 2012a; Nguyen et al. 2014). Most micronutrients, including iron (24.8%), zinc (67%), vitamin B2 (40.4%), vitamin B12 (63.8%), vitamin A (27.1%), and folic acid (54.3%), were frequently insufficiently consumed by WRA (Laillou et al. 2012a; Nguyen et al. 2014). In Vietnam, where approximately 1.5 million babies are born annually, over 25% of young children under the age of five are stunted (General Statistics Office, 2016, Vietnam National Institute of Nutrition 2018). As mentioned earlier in Part 1, accumulating evidence showed that the mother's dietary status before and during pregnancy is strongly associated with birth outcomes and the baby's growth later in life. By employing a validated Food Frequency Questionnaire (FFQ) for use in Vietnamese adults, Nguyen et al (2018) investigated the diet profile of nearly 2000 pregnant women in three major cities of Vietnam, including, Ha Noi, Ho Chi Minh City, and Hai Phong. The study findings revealed that 50% of pregnant women failed to meet the recommended energy requirements during pregnancy. Furthermore, the average consumption levels of micronutrients necessary for pregnant women, including vitamin D, folate, iron, calcium, and zinc, fell significantly below the recommended nutrient intake. Multiple studies have consistently documented a notable rise in the occurrence of micronutrient deficiencies among Vietnamese pregnant women residing in suburban regions or facing lower socioeconomic circumstances (Tu et al. 2014; Nguyen et al. 2018; Tran et al. 2019). Specifically, deficiencies in vitamin A, folic acid, calcium, iron, and zinc have been consistently reported in these populations. Insufficient intake of micronutrient-dense foods, including fruits, milk, eggs, and fish, can explain this problem (Nguyen et al. 2018). Daily iron intake levels of pregnant women in Vietnam (mean: 9.4mg) were well below the level recommended by The International Federation of Gynaecology and Obstetrics (FIGO) for pregnant women (27mg/day) (Hanson et al. 2015). According to the more recent national nutrition report in 2018, 32.8% and 80.3% of Vietnamese pregnant women were deficient in iron and zinc, respectively (Ministry of Health 2018).

A study demonstrated there was a low proportion of pregnant Vietnamese women who took prenatal-essential vitamin supplements during the first six months of their pregnancy, with nearly 26% taking either multivitamin supplements or folate during this period, and 20.1% taking only folic acid supplements (Ha et al. 2019). These findings mean that nearly two-thirds of these women did not take folate during the first trimester, leaving them at risk of neural tube defects. These supplements are less likely to be consumed by women aged 30–34 years, those without a high level of education, those who are unemployed, and those who are pregnant for the first time or unplanned.

Inadequate gestational weight gain among women in Vietnam

One-third of Vietnamese women are categorized as underweight at the time of prenatal booking and fail to meet the recommended weight guidelines set by the Institute of Medicine (Tran et al. 2019). Similarly, a prospective cohort study of about 3000 urban pregnant Vietnamese women in Vietnam demonstrated the proportion of pregnant women with low prenatal BMI ($< 18.5 \text{ kg/m}^2$) was high (26%) (Ota et al. 2011). Among women with a low prenatal BMI, the risk of delivering a baby classified as too small for gestational age (SGA) was found to be the highest at 18.1%, as compared to those with a normal prenatal BMI range of $18.5\text{--}22.9 \text{ kg/m}^2$ and those with a high BMI ($\geq 23.0 \text{ kg/m}^2$). A more recent study by Young et al. (2017) of about 1400 pregnant women in a province in northeast Vietnam (Thai Nguyen province) revealed that nearly 75% of participants gained weight below the recommended weight guidelines set by the Institute of Medicine and these women had a 2.5-fold increased risk of delivering a baby classified as too small for gestational age. Notably, up to 31% of participants had prenatal-BMI ($< 18.5 \text{ kg/m}^2$). By measuring the foetal ultrasound growth, the study also confirmed that the first 20 weeks of pregnancy has the greatest relative influence on foetal growth and risk of SGA. Inadequate gestational weight gain is significantly prevalent in other Asian populations (Pongcharoen 2016; Xiao et al. 2017; Young et al. 2017). There was a positive association between inadequate gestational weight gain and poor pregnancy outcomes (Nomura et al. 2017, Ota et al. 2011). Findings from meta-analyses conducted in lower-middle-income countries, Vietnam among them, found that poor dietary status and insufficient weight gain in pregnancy are linked to a 30% higher risk of premature birth as well as a substantial 70% increase in the likelihood of delivering infants classified as small for gestational age or with low birth weight (Rahman et al. 2015; Liu et al. 2016).

In addition, studies found that the excessive weight gain during pregnancy may serve as a predictive factor for retaining weight at 6 months after childbirth and an elevated risk of

encountering difficulties in weight management in the future (Nehring et al. 2011, Haugen et al. 2014; Kirkegaard et al. 2014). A prospective cohort study of around 2000 pregnant women in three cities of Vietnam (Hanoi, Haiphong and Ho Chi Minh City) by Ha et al. (2019) demonstrated that women with either low prenatal BMI or excessive gestational weight gain were more likely to retain greater weight 1 year after giving birth. A meta-analytic study by Nehring et al. (2011) involving over 65,000 women demonstrated that those who exceeded the recommended weight guidelines set by the Institute of Medicine were found to have an increased weight gain of 3 kg at 3 years and 4.7 kg at 15 years following childbirth, in contrast to those who adhered to the GWG recommendations.

Interventions and challenges for improving maternal nutrition in Vietnam.

A few interventions improving dietary quality during pregnancy have been reported in Vietnam although poor maternal nutrition remains a public health issue in this country. To date, there were two food-based and dietary supplement intervention trials in Vietnam. A randomised control trial in Vietnam examined the effect of a multiple micronutrient supplements on maternal diet and nutritional status as well as the outcome of birth weight (Nguyen et al. 2016). More than 5000 Vietnamese women were randomly allocated to the control group (only received a folic acid supplement), or the intervention groups (either received an iron and folic acid supplement or a multiple micronutrient supplements) from preconception to delivery. Of these participants, 1853 women became pregnant and went through the analysis until delivery. Plasma ferritin concentrations in cord blood and mothers were collected to examine the outcome of the maternal nutrition status. The finding of the trial showed there were modest improvements in iron stores during pregnancy among women in the intervention groups but failed to find a positive effect of a multiple micronutrient supplements taken prior to conception on the maternal nutrition status among the groups.

Similarly, another RCT investigated the effect of food-based supplementation in improving maternal diet and nutritional status as well as the outcome of birth weight (Nga et al. 2020). 460 participants were randomly allocated to either the interventional group or the control group. In the interventional arms of the RCT, women received the nutrient-rich, food-based supplement either from conception to term or from mid-gestation to term. Participants in the control arm received standard care. The nutrient-rich, food-based supplements were ready meals, which supplied 10% of the daily calorie requirement and at least 50% of a pregnant woman's recommended dietary allowance for five nutrients, including folate, vitamin B12, vitamin A, zinc, and iron. The design of meals in the trial was based on the national guideline

for Vietnamese women of reproductive age. The finding of the RCT demonstrated that there was an increase in the status of iron and folic acids between the intervention groups, but no statistically significant difference between the intervention groups and the control group in maternal diet and nutritional status. Moreover, the food supplement intervention also failed to improve birth outcomes. There were some limitations in the RCT including a small sample size, the high dropout rate of participants (about 31%) and lack of the full compliance with the study. The authors of the RCT did recognise many participants did not consume all the scheduled supplemental meals.

There is some evidence in the literature to suggest, that there was a limitation of the dietary supplement or food-based supplement approach alone in reducing the risk of malnutrition, particularly multiple micronutrient deficiencies, in regions where malnutrition during pregnancy is prevalent, such as in Southeast Asia (Ferguson et al. 2019). Analysing the data from five Southeast Asian countries including Vietnam, Ferguson et al. (2019) emphasised that pregnant women had the highest numbers of problem nutrients among six high-risk populations (incl. children aged 6-8 months, children aged 9-11 months, children aged 12-23 months, lactating women adolescent girls, pregnant women, and non-pregnant and non-lactating women). It should be noted that adopting a food-based supplement approach alone may not effectively reduce the risk of micronutrient deficiency among pregnant women, particularly regarding iron, calcium, and folate, owing to various factors such as educational level, age, physical activity, and income, as highlighted in a study by Ferguson et al. (2019).

Multiple factors such as family, health conditions (e.g., morning sickness), food taboos, and beliefs regarding the health benefits of dietary supplements have been also identified as influencers of food or dietary supplement intake by pregnant women in previous studies (Kavle & Landry 2018; Martin et al. 2020), even when foods or dietary supplements are readily available. Additionally, male partners, mothers, and other family members are highly influential (Aubel 2012) and can either promote or deter the adoption of recommended practices during pregnancy (Nagata et al. 2012). Therefore, a multifaceted approach that addresses these factors is necessary to effectively reduce the risk of undernutrition among pregnant women. Evidence suggests that implementing dietary behaviour change interventions during pregnancy can improve maternal nutritional status and reduce the occurrence of small for gestational age, low birth weight, and premature birth (Stevens et al. 2015; Gresham et al. 2016; von Salmuth et al. 2021). Although there are fewer studies in developing countries, interventions targeting healthy eating behaviours have shown promise in improving maternal nutritional status and protecting against the risks of low birth weight

and premature birth. Research conducted in developing countries, including Malawi (Ziyenda Katenga-Kaunda 2020) and various Southeast Asian countries (UNICEF East Asia and Pacific Region 2021), has suggested that interventions targeting healthy eating behaviours during pregnancy, either alone or in combination with education, can effectively manage gestational weight gain, increase awareness of the importance of nutritious diets, and improve dietary diversity among pregnant women.

Additionally, to enhance the efficacy of interventions aimed at promoting healthy eating behaviours among pregnant women, it is imperative to acknowledge and address the underlying barriers and facilitators that influence such behaviours, rather than solely focusing on the behaviour change techniques themselves (Kavle et al. 2018, Martin et al. 2020). This is because dietary patterns and preferences may vary across cultures and regions. A thorough understanding of the cultural, social factors that influence eating behaviours can help tailor interventions to the specific needs of the population and increase their effectiveness.

To the best of my knowledge, there are no behaviour change interventions targeting healthy eating during pregnancy in Vietnam. A previous qualitative study conducted by Nechitilo et al. (2016) investigated the beliefs and attitudes of Vietnamese women towards preconception and prenatal micronutrient supplementation. Their findings revealed that low awareness of health benefits, deficiency risks, side effects, and forgetfulness were significant barriers to supplement adherence during pregnancy. However, the study had limitations because the participants were a mixed group of pregnant and non-pregnant women and were recruited from one clinical trial on dietary supplementation, which might have resulted in higher adherence rates than expected in the general population. Furthermore, the study only focused on prenatal micronutrient supplementation rather than broader healthy eating behaviours during pregnancy. To date, there are no qualitative studies in Vietnam exploring attitudes and motivations towards healthy eating behaviours during pregnancy among Vietnamese women. This literature gap highlights the need for further research to better understand the factors that influence healthy eating behaviours among pregnant women in Vietnam.

Part 3: Factors influencing healthy eating behaviours during pregnancy.

Previous sections have demonstrated that inadequate micronutrient intakes and insufficient weight gain are prevalent among pregnant women in Vietnam. However, interventions to improve maternal nutritional status have focused primarily on diet diversification and antenatal micronutrient supplementation, with limited attention paid to promoting healthy eating behaviours during pregnancy in this population (Nguyen et al. 2016; Nga et al. 2020). Moreover, no studies have yet examined the factors that influence healthy eating among pregnant women in Vietnam, leaving a significant knowledge gap in the current understanding of maternal nutrition in the country.

Studies in the Southeast Asian region have identified various factors that influence healthy eating during pregnancy among women. Low knowledge or misunderstanding of healthy diet and weight gain during pregnancy have been identified as one of the primary factors affecting dietary habits among pregnant women in this region (UNICEF East Asia and Pacific Region 2021). Cultural beliefs and food taboos are also reported to influence the dietary habits of pregnant women in many cultures in this region (Köhler et al. 2018). Moreover, information sources about diet and weight gain during pregnancy and social support are other factors affecting healthy eating among pregnant women in Southeast Asia (Yamashita et al. 2021; UNICEF East Asia and Pacific Region 2021). The following sections aimed to examine these factors and contextualizing them within the Vietnamese context can provide a more comprehensive understanding of the factors that influence healthy eating behaviours during pregnancy.

2.9 Knowledge of healthy diet during pregnancy

Numerous studies in Southeast Asian countries have examined the knowledge of pregnant women regarding nutrition during pregnancy. Studies conducted in Indonesia, the Philippines, and Lao PDR revealed that while some women possessed a basic understanding of what constitutes a "healthy" diet during pregnancy, knowledge levels varied significantly among participants (Hartini et al. 2005; Yamashita et al. 2021; Smith et al. 2022). For instance, many pregnant women in the Philippines lacked knowledge about nutritional sources and the importance of frequent meals, which were significantly associated with low dietary diversity (Yamashita et al. 2021). Similarly, pregnant women in Lao PDR who were unaware of the specific nutrients required during pregnancy and the benefits of micronutrient supplements had low micronutrient intake and low adherence to supplements (Smith et al. 2022).

It is noteworthy that some pregnant women expressed limited understanding of the link between maternal nutrition and the risk of complications like gestational diabetes mellitus (GDM) and anaemia. For instance, a study conducted by Darmawati et al. (2020) through focus group discussions in Aceh, Indonesia, found that pregnant women had insufficient knowledge of anaemia and held misconceptions about the importance of diet in preventing it. Likewise, an online survey of 100 self-reported pregnant women with GDM in Vietnam's two largest cities, Ho Chi Minh and Hanoi, revealed that more than 50% of respondents had limited knowledge about the sources and amounts of carbohydrates in food, as well as a lack of literacy in reading nutrition labels. However, the study's limitations included self-reporting and a small sample size. To date, no study has investigated the knowledge of the general pregnant population in Vietnam.

Taken together, these findings from Southeast Asian populations underscore the existence of a lack of knowledge or misconceptions about healthy dietary practices among pregnant women in some countries in the region. As such, further research is needed to address this critical issue in the context of Vietnamese pregnant women to enhance their knowledge and promote better dietary practices.

2.10 Socio-cultural beliefs

Cultural beliefs and food taboos, in pregnant women represent an important aspect of maternal nutrition that can have significant impacts on foetal health and development. These beliefs and taboos may be shaped by cultural practices, religious customs, and family traditions, and can vary greatly across different cultures and societies. In some cultures, specific foods may be recommended or avoided during pregnancy based on their perceived effects on foetal health, while in others, certain dietary practices may be mandated by religious or cultural traditions. These beliefs and practices can have a significant impact on the dietary choices of pregnant women and may impact the health and well-being of both the mother and developing foetus. Understanding the cultural beliefs and food taboos of pregnant women is critical for healthcare providers who seek to provide culturally sensitive nutrition guidance to support healthy pregnancies and foetal development.

Culture beliefs

Cultural beliefs and values may affect health beliefs and behaviours (Helman 2007). A health belief can be described as a personal belief that influences health behaviour (Rosenstock et al. 1988). As Helman (2007) points out, health beliefs can impact self-care, healthcare-seeking behaviour, as well as risk awareness. In previous research on Southeast Asian populations, it was found that young women's food preparation and consumption practices

are strongly influenced by cultural traditions and family expectations (Agus et al. 2012; Suwanpratest 2019). Cultural beliefs are beliefs that are learned and shared across groups of people, no matter what the scientific validity is (Hatah et al. 2015). Food is often used as a means of retaining an individual's cultural identity. People also connect to their cultural or ethnic groups through food patterns. Cultural beliefs may interfere with the decision-making of pregnant women to consume or eliminate a certain food, or a group of foods. Cultural beliefs influence how different cultural groups perceive the relationship between health and illness. The concept of hot and cold dichotomy, which is prevalent in various cultures worldwide, including Chinese and Latin American cultures, reflects a naturalistic system (Bodo et al. 1999; Helman 2007). Vietnam and China shared several similar cultures. In Vietnamese society, Chinese traditional medicine has been accepted since the 1200s (Dung and Bodeker 2001; Adorisio et al. 2016) and somewhat influenced the Vietnamese diet. In line with the hot and cold dichotomy of Chinese culture, the explanation of illness in Vietnam is based on the principles of universal balance and harmony between the opposing forces of Yin and Yang, referred to as 'Am' and 'Duong' (Bodo et al. 1999; Lundberg and Trieu 2011). Am or Yin is considered as the quality of being “cold”, which includes leaf vegetables, and fruits while duong or yang is the aspect of being “hot”, which consists of fatty foods, salts, chilis, and red meats (Avieli 2011). The classifications of hot or cold foods refer to the beliefs about how these foods affect the body once consumed. Consumption of hot foods can increase the heat of the body. In contrast, the intake of cold foods can make the body colder. Thus, the preventative approach to a certain disease is to maintain the balance between the opposing forces of ‘hot’ and ‘cold.’ (Tu 2001). Pregnancy is traditionally thought of as an ‘unstable, weak’ period, which is prone to an imbalance. Notably, the first trimester is known as the ‘cold’ and the weakest state. Thus, historically Vietnamese women are advised to avoid ‘cold’ foods while hot foods are appropriate. However, it is commonly believed that consuming very hot foods like chili and alcohol should be avoided due to the risk of miscarriages (Manderson and Mathews, 1981; Dang et al. 2021). A study from a metropolitan city in Vietnam, Ho Chi Minh city, investigating cultural beliefs and practises in the postpartum period shows that cultural beliefs such as restoring the balance between ‘Am and Duong’ still prevail (Lundberg and Trieu 2011). The practices include a ‘hot and cold’ diet, and behavioural precautions such as keeping warm, staying indoors, resting in bed, and avoiding housework and sexual activities (Lundberg and Trieu 2011). However, to date, no studies in Vietnam about the ‘Am and Duong’ harmony among pregnant women has reported since studies in 1981 by Manderson and Mathews.

Food taboos

Food taboos are practices in many cultures that involve avoiding certain foods during and after pregnancy to protect the health of both the mother and child. Pregnant women in many cultures avoid consuming foods of high nutrient value due to cultural taboos and misinformation, as documented in various studies (Hartini et al. 2005; Holmes et al. 2007; Huybregts et al. 2009; Lakshmi, 2013). A study in Indonesia by Hartini et al. (2005) demonstrated expectant mothers often eliminate 5 types of meat or animal-source foods, 14 types of vegetables, 14 types of fruits, and 10 types of fish from their diets based on the belief that these foods are detrimental to the health of both the mother and foetus. Additionally, cultural beliefs also lead to the avoidance of certain foods like fish, beef, and duck due to the belief that they cause larger babies and difficult labour during delivery (Choudhury and Ahmed, 2011). These food avoidance practices can limit nutrient intake and potentially contribute to maternal and foetal malnutrition. Systematic reviews have shown that adopting food taboos, whether related to plant or animal sources, can increase the risk of nutrient deficiency during pregnancy (Siega-Riz et al. 2009).

Systematic reviews (Köhler et al. 2018; Köhler et al. 2019) has highlighted the prevalence of food taboos among pregnant women in Southeast Asia. The reviews focused on exploring food taboos during pregnancy and the postpartum period in ten Southeast Asian countries. The authors identified 42 studies from seven Southeast Asian countries, but none were available from Brunei, Singapore, and Vietnam. The reviews highlight the prevalence of food taboos during pregnancy in different regions and provide examples of taboos and associated beliefs from various countries. For instance, in Indonesia, it is believed that consuming river or seafood such as catfish, eel, or shrimp during pregnancy can result in a difficult delivery as the foetus may become positioned upside down in the womb. Similarly, some pregnant women in the Philippines avoid eel and shrimp consumption, fearing it may cause a delay in delivery, while pregnant women in Lao PDR avoid domestic animals with babies, fearing difficulty in childbirth (Köhler et al. 2019). One potential limitation of the systematic reviews conducted by Köhler et al. (2018; 2019) is the possibility of publication bias, as the authors only included studies that were published and written in English. By exclusively including studies published and written in English, there is a possibility that relevant studies published in other languages were overlooked, which could have restricted the overall comprehensiveness of the review. Additionally, the studies included in the reviews used different methodologies and definitions of food taboos, which may limit the comparability of the findings across studies and regions. Despite these limitations, the reviews provide valuable insights into the prevalence and impact of food taboos on the

dietary practices of pregnant women in Southeast Asia. The findings underscore the need for further research on this topic in underrepresented areas such as Brunei, Singapore, and Vietnam to better understand the cultural beliefs and dietary practices of pregnant women in these regions. Understanding the prevalence of food taboos during pregnancy and their associated beliefs is crucial for developing culturally appropriate dietary recommendations for pregnant women. To the best of my knowledge, no studies have yet investigated food taboos during pregnancy in Vietnam, although some studies have reported food taboos regarding seafood and chicken consumption during breastfeeding (Lundberg and Trieu 2011).

2.11 Male partners and family members

The previous section addressed the prevalence of cultural beliefs and food taboos among pregnant women in many cultures and their potential impact on healthy eating during pregnancy among women. However, promoting healthy eating during pregnancy is not solely the responsibility of the pregnant woman. Family members and partners, as well as healthcare providers, can significantly impact a woman's eating behaviour and, therefore, her ability to maintain a healthy diet. This section will explore the role of male partners and senior family members, such as mothers and sisters, as well as healthcare providers, in promoting healthy eating behaviours during pregnancy. By examining the influence of these three key stakeholders, a more comprehensive understanding of the factors that influence healthy eating during pregnancy can be achieved, and potential avenues for intervention can be identified.

In some cultures, such as Lao PDR and Malaysia, grandmothers and older women play a significant role in providing advice and support to younger pregnant women, who view them as a trusted source of information (de Sa et al. 2013; Sychareun et al. 2013). The studies suggest that grandmothers and elder women play an essential role in maternal and child health outcomes by providing information on traditional practices and cultural beliefs regarding pregnancy, childbirth, and postpartum care. Despite the important role of grandmothers and elder women in these cultures, some studies have highlighted the need for providing them with updated and evidence-based information on maternal and child health to enhance their support to younger pregnant women (de Sa et al. 2013). In a systematic review encompassing 23 studies conducted in low- and middle-income countries, Kavle and Landry (2018) identified that social support from male partners and senior family members, including mothers and sisters, plays a facilitative role in a woman's weight management during pregnancy. This support is manifested through positive actions such as assisting with

cooking healthy foods and procuring groceries. However, Vanstone et al. (2017) noted that the food preferences of family members play a significant role in determining the type of food that is purchased, prepared, and consumed in the home, highlighting the importance of family support in promoting healthy eating behaviour during pregnancy.

In Vietnam, some studies have reported that family members may hold misconceptions about healthy eating during pregnancy that can result in pressure on expectant mothers to modify their diets in ways that may not align with current recommendations. For example, some family members including husbands may discourage the consumption of fruits and vegetables due to beliefs about "cold" foods, while others may encourage higher protein intake for breastmilk production (Lundberg et al. 2012; Kavle and Landry 2018, p.8). According to a report by Metechkina et al. (2014), in the modern culture of Vietnam, husbands now actively contribute to the well-being of their children and share the responsibility for ensuring their health alongside their partners. This shift can be attributed to the significant changes in the role of women within the family, driven by economic reforms and improved access to education (Lam and Laura, 2017). Nevertheless, the perception of Vietnamese husbands as authoritative figures within their families persists, largely due to their responsibility for making decisions regarding the household budget (Locke et al. 2012).

Active involvement of fathers in antenatal care has been found to positively impact their own knowledge and the overall well-being of their partners. A systematic review and meta-analysis of data from lower-middle-income countries demonstrated that husbands who participated in antenatal care sessions experienced significant improvements in their knowledge compared to those who did not (Suandi et al. 2019). This increase in knowledge was strongly associated with enhanced maternal and child health outcomes. The study revealed that it resulted in increased utilization of antenatal care services, increased consumption of healthy food, and heightened awareness of pregnancy-related danger signs. These factors collectively contribute to improved health outcomes for both mothers and children (Suandi et al. 2019). However, it is worth noting that fathers with a low level of education and income may be less inclined to engage in antenatal education with their partners, as highlighted by Sevil and Ozkan (2009).

2.12 Sources of information on nutrition and diet during pregnancy

Information sources on healthy eating during pregnancy in Southeast Asian countries vary widely and include a combination of traditional and modern sources. Studies have shown that in Lao PDR, Indonesia, and Vietnam, women rely on advice from their mothers,

grandmothers, and other female family members, as well as traditional birth attendants and midwives, for information on healthy eating during pregnancy (Hartini et al. 2005; de Sa et al. 2013; Kavle and Landry 2018). In addition, healthcare professionals such as doctors, nurses, and nutritionists are also seen as trusted sources of information, although access to healthcare can be limited in some rural areas.

Recent studies indicate a growing trend of using modern sources, such as the internet and social media, to access information on healthy eating during pregnancy. In Indonesia, for example, women are turning to the internet to gather knowledge on maintaining a healthy diet while expecting and to connect with fellow mothers to share experiences (Ariyani et al. 2020). Similarly, an online survey conducted among approximately 10,500 women across Thailand, Singapore, Indonesia, and Malaysia, who are either pregnant or raising children, revealed that around 80% of respondents increased their internet usage after becoming mothers, primarily seeking information on health and nutrition tips (72%) and parenting advice (92%) (Huang 2014). The survey also highlighted the widespread use of social media among these women, with 98% actively using Facebook. Similarly, a separate survey conducted among 500 Vietnamese mothers, including both pregnant (42%) and non-pregnant (58%) individuals, showed that approximately 98% of them were active Facebook users (The Asian Parent 2021). The findings also indicated that these women spend an average of three hours per day on social media, with a particular emphasis on maximizing their time on Facebook.

Nevertheless, it is important to acknowledge the potential drawbacks of relying solely on online sources for information on healthy eating during pregnancy. The availability of vast and sometimes conflicting information online raises concerns about accuracy and reliability. Therefore, it is crucial to provide women with guidance on how to assess and evaluate the information they come across. A balanced approach that combines both traditional and modern sources of information is recommended. This ensures that women receive accurate and culturally appropriate guidance regarding their dietary choices during pregnancy.

Conclusions of the literature review

Promoting healthy eating behaviours during pregnancy is crucial for the health of both mother and unborn baby. Despite existing policies and guidelines on maternal nutrition in Vietnam, undernutrition and inadequate weight gain during pregnancy continue to be a public health concern in the country. Previous interventions in this country such as supplements or food-based clinical trials have shown limitations in improving maternal nutrition and birth outcomes, indicating the need for a more comprehensive approach.

Complex factors influencing healthy eating behaviour during pregnancy in Vietnam include knowledge, sources of information on nutrition and diet during pregnancy, food cultures, food taboos, and the involvement of male partners and family members. Addressing these factors requires a multi-faceted approach. Behaviour change interventions that take into account these factors may be more effective in promoting healthy eating behaviours during pregnancy in Vietnam. However, to date, there have been no behaviour change interventions. Additionally, no studies investigating factors influencing healthy eating behaviours during pregnancy among Vietnamese women have been reported.

Therefore, qualitative research is needed as the first step to better understand the barriers and facilitators to healthy eating behaviours during pregnancy among Vietnamese women. The insights gained from this can inform the development of interventions that promote healthy eating behaviours during pregnancy tailored to this population. The subsequent chapter outlines the study's objectives, research questions, and methodology, based on the findings of the literature review.

Chapter 3: Aims, Research Questions, and Methodology

The previous chapter has provided evidence of high prevalence of undernutrition and inadequate weight gain among pregnant women in Vietnam, which remains a public health concern in the country. Additionally, it highlighted the limitations of current interventions based on micronutrient supplements or foods to improve the nutrition status of this population. Through a review of existing literature in Vietnam and other Southeast Asian countries (see Part 3), multiple factors influencing women's behaviours regarding healthy eating and weight gain during pregnancy were identified, emphasizing the critical need for behaviour change interventions that promote healthy eating during pregnancy for women in Vietnam. Unfortunately, to date, no study has explored the attitudes and motivations of Vietnamese women towards healthy eating behaviours during pregnancy. Consequently, utilizing the Medical Research Council (MRC) guidelines (Skivington et al. 2021) for developing a complex intervention, this thesis serves as an intervention development study with two aims.

The first aim is to explore attitudes and motivations toward healthy eating and weight gain behaviours during pregnancy among Vietnamese women of mixed socioeconomic backgrounds by conducting a qualitative study. It will explore:

- (1) Have they in practice changed their food habits since they became pregnant?
- (2) What do they think about a healthy diet, food restrictions, weight gain during pregnancy?
- (3) Where did they obtain their nutrition-related information?
- (4) What barriers were there to apply this knowledge to their dietary practices?

Based on the findings of the qualitative study above, the second aim is to develop a logic model that examines feasible and efficient components for a healthy eating behaviour intervention among this population.

To accomplish the aims of the study, the subsequent sections of this chapter provide a comprehensive understanding of the research methodology. It begins by presenting the MRC framework that guided the study. It then provides a detailed description of the study design. It includes rationales for utilizing a qualitative approach and focus group interviews as the chosen method of data collection. Justification is given for the application of thematic analysis as the preferred method for data analysis and the rationale behind integrating the Capability, Opportunity, Motivation to Behaviour (COM-B) model and Theoretical

Domains Framework (TDF) to structure the extracted themes from the data is clarified. It ultimately presents the methodology for constructing the logic model.

3.1 The MRC framework used to guide the current study.

The UK Medical Research Council (MRC) emphasises that the use of appropriate theory in the development of complex interventions is a good practice (Craig et al. 2008; Skivington et al. 2021). According to the MRC's definition (Skivington et al. 2021, p.2), an intervention can be considered complex if it involves multiple interacting components, such as “the number of components involved; the range of behaviours targeted; expertise and skills required by those delivering and receiving the intervention; the number of groups, settings, or levels targeted; or the permitted level of flexibility of the intervention or its components.” As stated in Chapter 2, eating behaviour is shaped by a range of interconnected factors, such as cultural beliefs and taboos, social networks including family and friends, medical professionals, social context, and access to information sources, all of which make up an individual's behavioural system. Undoubtedly, the dietary behaviour interventions that I intend to develop are consistent with the MRC's description of complex interventions. Moreover, the MRC Framework, which was initially introduced in 2000 and has since undergone updates in 2006, 2008, and 2021, has demonstrated successful application across a variety of health disciplines in developed and developing countries for designing and evaluating complex interventions (Lakshman et al. 2014; Vousden et al. 2018; Bobrow et al. 2018; Dumont et al. 2020; Lewis et al. 2022). This suggests that the MRC Framework's versatile and non-linear approach may serve as a valuable framework for in creating behaviour-based interventions for pregnant women in Vietnam. Thus, my approach to developing a dietary behaviour intervention for pregnant women in Vietnam is guided by the MRC framework (Skivington et al. 2021) as a theoretical framework.

To design and evaluate complex interventions, the latest MRC framework (Skivington et al. 2021) provides a four-stage framework including development, feasibility/piloting, evaluation, and implementation. According to this MRC framework, the development stage is the starting point of a complex intervention, which needs to be built upon the theory and evidence available (Skivington et al. 2021). Figure 1 illustrates that the development phase of the MRC framework comprises six essential elements: stakeholders, key uncertainties, context, programme theory, intervention refinement, and economic considerations. It is important to highlight that the development phase encompasses the progression from the initial concept to feasibility, pilot, or evaluation stages. In this thesis, the primary focus is on

shaping the initial concept of intervention development, with emphasis on four key components outlined below.

- Identifying stakeholders who are directly impacted by the intervention helps ensure their perspectives are considered throughout the research and development process.
- Identifying key uncertainties or problems based on existing knowledge guides the formulation of research questions and determines the choice of research perspective.
- Context comprehension involves recognizing any element of the circumstances surrounding the conception and development of an intervention. The effectiveness of complex interventions is strongly influenced by the context in which they are implemented, with factors such as physical, social, organizational, cultural, and economic features playing a pivotal role in determining their outcomes.
- Programme theory outlines how an intervention is expected to generate its effects and under which conditions, and it should be continuously tested, refined, and used to identify uncertainties and research questions.

In addition, the MRC has published a comprehensive guidance that provides detailed instructions for the development phase of complex interventions aimed at enhancing healthcare improvement. (O'Cathain et al. 2019). The guidance emphasised that conducting a comprehensive review of published research evidence is essential before and throughout the development of an intervention. It helps define the health problem, understand the context, identify existing effective interventions, determine target stakeholders, and uncover facilitators, barriers, and uncertainties. Continuously reviewing evidence allows intervention developers to stay updated on new interventions and consider potential limitations or challenges that may arise. While conducting systematic reviews may not always be feasible, it is crucial to undertake some level of review to ensure the proposed intervention remains relevant and fills a necessary gap. As outlined in Chapter 2, there are limitations associated with existing interventions focused solely on supplements or dietary modifications to enhance healthy eating and gestational weight gain among pregnant women in Vietnam. Moreover, there is a scarcity of literature exploring the factors that influence these behaviours within this specific population. Consequently, the purpose of the present thesis is to build the evidence base for the development of the complex intervention. The MRC guidance encourages the researchers to use a range of research methods including quantitative research method, qualitative research method, or mixed methods to have a sound theoretical understanding of the context in which the intervention will operate.

Qualitative research may be used to generate primary data in the development stage of complex interventions. O'Cathain and colleagues (2019, p.7) emphasized that “qualitative interviews with the target population or patient group can identify what matters most to people, their lived experience or why people behave as they do”. In this thesis, a qualitative study was used to identify enablers and barriers to healthy eating behaviours among pregnant women in Vietnam; reasons for this choice is justified in Section 3.2.1. This qualitative research provides a theoretical basis to begin understanding the behaviour of pregnant women regarding healthy eating and weight gain. A comprehensive theoretical understanding of behaviour change can optimize the effectiveness and reach of interventions (Davis et al. 2015). Then, the outcomes of the qualitative research will be utilized to construct a logical model for the proposed intervention aimed at promoting healthy eating behaviour among pregnant women (see Chapter 6). As described in Figure 2, an overview of the present study, is based on the development stage of the 2021 MCR guidance.

3.2 Research design and methodology: qualitative study

This section provides the rationale for implementing the qualitative research to identify the evidence base for this thesis and describes the study design to achieve the first aim of the thesis. Additionally, it presents justification for employing online focus group discussions as a data collection tool and utilizing theoretical frameworks such as the COM-B model in the behaviour change wheel and theoretical domains framework (TDF) to structure the extracted themes from the data.

3.2.1 Philosophy and the Choice of Qualitative Research

The adoption of a qualitative research approach in this study was rooted in its inherent capacity to address the research questions that were designed to explore Vietnamese pregnant women's attitudes and motivations regarding healthy eating and weight gain behaviours. The use of qualitative research methods is in line with the prevailing wisdom in the field. As Creswell (2013) notes, epistemology characterizes the theory of knowledge, particularly concerning beliefs about the nature of knowledge and the methods employed in its acquisition. Epistemologically, qualitative research aligns with the principles of social constructivism, which focuses on understanding and interpreting human experiences (Guba & Lincoln, 1994). Social constructivism acknowledges that knowledge is constructed within specific socio-cultural contexts, and in this case, it recognizes that the knowledge about attitudes and motivations toward healthy eating and weight gain behaviours is subjective and context-dependent. By adhering to this epistemological framework, the study acknowledges that knowledge is not objective but is created and interpreted by individuals within a

particular social and cultural context. The constructivist approach emphasizes the need for an interactive and interpretive process between the researcher and the research participants. As Schwandt (2007) posits, a constructivist approach entails a dialectical relationship between the researcher and the researched, with the researcher actively engaging in the interpretation of participants' perspectives. This approach allows for a deeper understanding of the meanings participants ascribe to their attitudes and motivations related to healthy eating and weight gain behaviours, which is the central objective of this research.

Furthermore, qualitative research involves a holistic approach, where the researchers look at the events regarding the social, cultural and physical environments of the people they are studying (Tashakkori & Teddlie, 2003). Moreover, qualitative research serves as a valuable tool for developing a theoretical understanding of the target behaviour, particularly in cases where limited knowledge exists about the population involved (Rubinstein 2015; Islam 2012, Cadogan 2016). A qualitative approach allowed me to consider why pregnant women think or behave the way that they do and how they come to understand healthy eating in their real lives. It also allows the voice of pregnant women to be included in the development of subsequent interventions (Bryman, 2008). Unlike quantitative research that tests or measures the effect of a phenomenon, the qualitative approach aims to provide insight and understanding of that experience, and the meaning that is attached to it (Hammarberg 2016).

In sum, the choice of a qualitative research approach in this study is rooted in a robust theoretical and epistemological foundation. This approach is well-suited to explore and unravel the complex fabric of attitudes and motivations among Vietnamese pregnant women regarding healthy eating and weight gain behaviours, considering the context-bound and interpretive nature of the knowledge sought in this research.

3.2.2 A qualitative study design

This section provides a detail of the qualitative study design using online focus groups involving Vietnamese pregnant women to explore their attitudes and motivations toward healthy eating and weight gain behaviours during pregnancy. This includes recruitment, sampling, data collection, data analysis and ethical considerations. Additionally, it provides justification for using the theme analysis as a data analysis tool and utilizing research frameworks such as the COM-B model in the behaviour change wheel and theoretical domains framework (TDF) to organize the extracted themes from the data.

3.2.2.1. Recruitment

Recruiting through Facebook was a strategic decision for various reasons. First, the COVID-19 pandemic restricted physical contact, making online recruitment a practical solution. Second, Vietnam ranks 12th globally and 2nd among ASEAN countries in terms of the total number of internet users, as nearly 74% of the population and 99.37% of hamlets and villages in the country have internet access (Ministry of Information and Communications 2022). Additionally, a study conducted by YouNet Media (2017) indicated that Facebook is the go-to platform for 90% of mothers in Vietnam to seek information about pregnancy, birth experiences, and maternity hospitals. Thus, advertisements were placed on Facebook to reach potential participants. A website link was provided to access participant information for the study, including my contact information as the main investigator (refer to Appendix 3), along with a separate link for online enrolment. Therefore, those who were interested in the study could read the study information or ask questions and have these answered satisfactorily by contacting me via phone and email. Once an individual expressed interest in participating in the study, they could access the provided link at the bottom to visit the enrolment site. At the enrolment site, they were required to provide informed consent by checking boxes, typing their name, and submitting the form (refer to Appendix 7). Following this, participants proceeded to complete a brief eligibility-screening questionnaire (refer to Appendix 4) to determine their suitability for inclusion in the study. During this process, the participant could cancel at any time by selecting the “exit” button on the enrolment site if they wanted to change their mind. Only eligible participants with fully completed informed consent were invited to join the study. Based on the contact information they provided, I contacted eligible participants via phone to confirm their participation and to organise them into focus groups.

3.2.2.2 Sampling

Vietnamese women who met the inclusion criteria below were eligible for this study.

Inclusion criteria

- Pregnant women aged 18 and older, who live in Vietnam.
- Ability to write, read and sign the consent form.
- Have access to a computer and the internet.

Exclusion criteria

- Have a diagnosis of specific medical conditions such as gestational diabetes, thyroid disorders, iron-deficiency anaemia, epilepsy, asthma, hypertension, or hypotension.

- Be currently receiving a specific diet or medication as advised by healthcare providers to manage the above medical conditions, including instances where medication or dietary recommendations have been made for the purpose of weight loss.

3.2.2.3 Data collection

Rationale for using online focus group interviews as data collection tool.

A focus group was chosen as a data collection tool for the present study. The utilization of focus groups for collecting qualitative data is widespread, as it empowers researchers to obtain a comprehensive understanding of participants' sociological and psychological perspectives. (Krueger, 2014)

Unlike individual interviews, focus group interviews may offer researchers a mean to enhance their comprehension of participants' viewpoints, group norms, and attitudes regarding the same topics. Furthermore, participant interaction fosters effective communication within the group, encouraging reflection on personal experiences and consideration of others' opinions. Wilkinson (1998) highlighted the usefulness of extensive information sharing among group participants in examining the obstacles and enablers to health behaviour. Gaining insights into barriers and facilitators can assist in the design of interventions aimed at enhancing outcomes. Ritchie et al. (2014) recommended that researchers foster an inclusive environment to promote effective focus group discussions, ensuring that all participants feel heard, valued, and encouraged to share diverse perspectives. It is also important to foster an environment in focus group discussions where reticent participants are encouraged to share information while also regulating the influence of dominant voices (Ritchie et al. 2014). Lastly, a focus group can generate a substantial volume of data within a relatively short period of time (Rabiee 2004).

A virtual approach was chosen to collect data from focus group interviews. The reason for this selection is because online focus groups (OFGs) have been increasingly used in the literature due to their benefits on cost-effectiveness and geographical distance (Murgado-Armenteros et al. 2012). Moreover, the emergence of the COVID-19 pandemic has underscored the significance of leveraging virtual approaches for data collection, as researchers globally face constraints on conducting in-person data collection due to mandatory physical distancing measures. The pandemic has also accelerated the adoption of online data collection methods among qualitative researchers. As a result, a number of studies during the pandemic using OFGs as a data collection method confirmed the

effectiveness of virtual focus group interviews (Temmesen et al. 2021; Lander et al. 2023). Compared with an in-person focus group, OFGs have “more commonalities than differences” (Stancanelli 2010, p. 764). In particular, Woodyatt et al. (2016) demonstrated that the number of emerging themes is not significantly different between traditional focus groups and OFGs. They also emphasized that OFGs are more feasible to collect data on sensitive or stigmatized topics, such as substance abuse, or sexual abuse as well as reach to hard-to-include populations such as cancer survivors, abused children, or pregnant adolescents, in comparison to traditional focus groups (Tates et al. 2009; Woodyatt et al. 2016).

While Fox et al. (2007) argued that OFGs are as dynamic and interactive as face-to-face focus groups, my study found that multiple research participants in the online focus groups spoke simultaneously, resulting in a diminished level of clarity and comprehension of individual responses. This can occur due to technical issues or due to participants' eagerness to contribute to the discussion. To address this issue, one solution was to establish clear guidelines for communication during the focus group. This could include reminding research participants to wait until others have finished speaking before contributing their own thoughts, or using a moderator to manage the discussion and ensure that each participant has a chance to speak. Additionally, using tools such as the "raise hand" function in online meeting platforms could help to ensure that everyone has an opportunity to contribute without speaking over one another. Clear communication guidelines and the use of moderation and communication tools can help to minimize the occurrence of participants speaking over one another and ensure that the focus group is a productive and informative experience for all involved.

In addition, I found that OFGs presented several challenges related to the online platform, including technological issues such as poor internet connectivity and difficulties with audio and visual quality. These issues can lead to interruptions or the inability to participate in the discussion, which can negatively impact the quality of the data collected. To address these challenges, it was recommended that research participants be provided with clear instructions for accessing and using the online platform, including troubleshooting steps for common technical issues. Additionally, it was important to ensure that participants have access to reliable and stable internet connections, and that audio and visual quality are tested prior to the start of the focus group. Addressing these challenges proactively can help to minimize the impact of technological issues on the quality of the focus group data and ensure a successful and productive focus group experience for all involved. A scoping review of 40

studies using OFGs to collect data in the field of rehabilitation sciences, conducted by Tran et al. (2021), revealed that technology literacy and access to technology might serve as barriers to virtual focus group interviews.

Regarding the format for conducting the focus groups, it also should be noted that my original plan was to conduct the focus groups remotely. The decision to utilize an online approach for conducting focus groups with pregnant women was based on several challenges associated with collecting data through in-person focus groups. These challenges include limited availability of participants due to pregnancy-related appointments and obligations, resulting in difficulties in scheduling focus group sessions that are convenient for all participants. Additionally, pregnant women may experience physical discomfort or other health-related issues that may impede their ability to participate in a focus group discussion. Furthermore, concerns regarding privacy and confidentiality may arise, particularly when discussing sensitive or personal information in a group setting. As a result, the online approach was chosen to address these challenges and ensure optimal participation and data quality. As such, there was no change in plans due to the COVID pandemic. While the pandemic did cause some logistical challenges, such as coordinating schedules and ensuring reliable internet connectivity for all participants, I was able to successfully conduct the focus groups as planned.

Facebook as a platform to collect data for virtual focus group interviews.

As mentioned early, online focus group interviews were chosen to collect data for the present study, based on the Facebook platform. Facebook (now known as Meta) is widely used as an effective platform for online focus groups in health studies (Lijadi and Schalkwyk, 2015; MacLeod et al. 2016; Thrul et al. 2017; Temmesen et al. 2021). In the present study, Facebook was utilised as the platform to conduct online focus interviews for several reasons. First, Facebook may be convenient and familiar to participants in Vietnam. As reported by Hootsuite (2020), Facebook, as the most popular social platform in Vietnam, has about 58 million users, 63% of whom are between the ages of 18 and 44, where the age group between 20 and 29 is the most common reproductive age in Vietnam (Vietnamese Central Population and Housing Census Steering Committee 2019). A study conducted by YouNet Media (2017) indicated that Facebook is the go-to platform for 90% of mothers in Vietnam to seek information about pregnancy, birth experiences, and maternity hospitals. This could potentially explain why Facebook has gained significant popularity, positioning it as the second most favoured online source of information in Vietnam, trailing just behind Google (Similarweb 2020). Logistically speaking, pregnant women in Vietnam may be familiar with

the functions and security settings of the Facebook platform. Lastly, Facebook offers unique features such as notifications and tags which may notify participants of new posts or others' comments. Facebook's a video conferencing feature, known as Messenger Rooms, also allows me to host video calls of a group of up to 50 participants as well as offers private groups with the highest level of privacy which only the invited individuals and I can access. Unlike other popular video call platforms such as Zoom and Microsoft Teams, it is a feature already available on the Facebook platform that people are familiar with. It is relatively simple to use and joining a room does not require any additional downloads. The other platforms may require additional downloads if they are not available on participants' devices therefore will be much less accessible, particularly for people who are less confident with technology.

Procedure of online focus groups to collect data.

Only participants who met the eligibility criteria and provided their consent forms were invited to the focus groups using the contact information (email or phone number) they had provided. To facilitate online focus groups, Messenger Rooms, a video conferencing feature developed by Facebook, was utilized. As mentioned early, Messenger Rooms allows me to create virtual rooms where I can host video calls with up to 50 participants, even if they do not have a Facebook account (Meta 2020). The focus groups were conducted within a private Facebook group, where participants were granted authorization to join. This setup allowed for secure and convenient video conferencing sessions using Messenger Rooms.

There were five focus groups, each consisting of 4 to 6 participants, and the duration of discussions ranged from 60 to 90 minutes. During the focus group session, I began by introducing myself as well as explaining the purpose and format of the discussion. Additionally, I emphasized the rights and responsibilities of research participants, which encompass the importance of upholding confidentiality and showing respect for the perspectives of others. Afterward, each participant was invited to introduce themselves and to share some thoughts about themselves, their pregnancy, and their lives. This introductory phase was designed to foster rapport and create a relaxed atmosphere. Throughout the main discussion, the discussion guide (refer to Appendix 6) was employed as needed to present the focus group questions and encourage participants to express their viewpoints. However, on occasions, some questions were pre-emptively addressed by the participants themselves. The facilitation of the discussion also involved the use of follow-up questions to prompt participants to provide more in-depth explanations and clarify their responses. Probing techniques were employed to stimulate participants to share their insights, without any

attempt to sway or influence their responses. All focus groups were conducted in the Vietnamese language.

During the focus groups, the discussions were audio-recorded by a good-quality digital recorder. I informed research participants that audio recordings of the discussions would be conducted for later analysis, as stated in the consent form. However, I also emphasized that they had the freedom to choose not to participate in the audio recording if they wished. All research participants in the study were willing to be recorded. The recorder automatically recorded the interviews via a wireless system, so the sound quality of the recordings was good for transcription. Each participant was assigned a unique code, which is identified in all data to ensure their confidentiality.

At the end of each focus group session, each research participant received an electronic 100,000 VND- gift voucher as a thank you and recognition for their time at the end of the study. Typically, in Vietnam, 100,000 VND is sufficient to purchase a decent meal for one person at a street food stall or a local restaurant in Vietnam. This meal may consist of a variety of options, including a bowl of noodle soup (Pho), a plate of rice with meat and vegetables, or a banh mi, along with a drink such as iced tea or sugar cane juice. A payment level of 100,000 VND in the present study is modest, which may not adversely influence judgments of risk and cloud the participants' choice. Resnik (2015) emphasised that a sufficiently large level of payment to participants might raise concerns about undue inducement on informed consent for their research participation. Moreover, the participants who devoted their time toward engaging in research activities deserve to receive a recognition for this.

Following each discussion, the interviews were transcribed verbatim by myself. I thoroughly reviewed the transcribed documents and cross-checked them with the original recordings to ensure accuracy in the translation process into English. This rigorous approach allowed me to achieve a comprehensive and precise translation.

3.2.2.4 Data Analysis

3.2.2.4.a Justification for the use of thematic analysis

At the outset of the study, different approaches to qualitative data collection and analysis were considered. The grounded theory (GT), a popular qualitative approach, was considered for this study at first. GT provided an approach to producing theories that would explain the complex social processes involved. Concerning this, I decided not to select GT since this present study was not designed to generate a theory by re-examining the data to make sure

the emerging concepts are representative of the data (Eyles & Smith, 1988). Another candidate was phenomenology. This approach is helpful to gain a deep understanding of subjective experiences and how individuals make sense of the world around them (Creswell 2007).

In this present study, the aim of the research is to explore the perspectives of the women on healthy eating and weight gain during their pregnancy rather to theorise their perspectives in relation to their social context or gain the understanding of their experiences. Thus, thematic analysis (TA) was chosen as the method for data analysis in this present study. TA has been widely used as a method for analysis in qualitative research (Braun & Clarke, 2006; Nowell et al. 2017). TA is a method of “identifying, analysing and reporting themes within data”, according to Braun and Clarke (2006, p.79). TA helps to generate themes that capture a phenomenon which is then interpreted (Ryan & Bernard, 2000). Typically, it is utilized for a series of written texts, like transcripts or discussions. Research has demonstrated that TA can provide insights into the perspectives of different participants, reveal similar and different viewpoints, and generate unexpected insights (Braun and Clarke 2006; King 2004). Furthermore, it is unbound by any epistemological or theoretical framework (Maguire and Delahunt, 2017). This is applicable to this study as the aim is to draw out themes of a set of translated transcripts of focus group interviews regarding perspectives of the women on healthy eating and weight gain during their pregnancy and then move onto interpretation.

In terms of the well-known TA approaches, I employed Braun and Clarke’s (2006) six-phases of thematic analysis. Six phases include familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining themes, and writing up (see Table 5). These are not necessarily linear phases; the researchers can move back and forth between phases several times, particularly when encountering complex data (Braun and Clarke 2006; Maguire and Delahunt 2017). Identifying themes is essential to the process of TA. Themes are described as "an idea or concept that captures and summarizes the essence of a coherent and meaningful pattern in the data" and as "a common, recurring pattern across a dataset, clustered around a central organising concept" (Braun and Clarke, 2019, p.2).

Table 5: Braun and Clarke (2006) six-step guide to thematic analysis, adapted from Clarke and Braun (2013, p.120-123)

Phase	Explanations
Familiarisation with data	The researcher must immerse themselves in, and become intimately familiar with, their data; reading and re-reading the data (and listening to audio-recorded data at least once, if relevant) and noting any initial analytic observations.
Coding	It involves generating pithy labels for important features of the data of relevance to the (broad) research question guiding the analysis. Coding is not simply a method of data reduction, it is also an analytic process, so codes capture both a semantic and conceptual reading of the data. The researcher codes every data item and ends this phase by collating all their codes and relevant data extracts.
Searching for themes	A theme is a coherent and meaningful pattern in the data relevant to the research question. Searching for themes is a bit like coding your codes to identify similarity in the data. This ‘searching’ is an active process; themes are not hidden in the data waiting to be discovered by the intrepid researcher, rather the researcher constructs themes. The researcher ends this phase by collating all the coded data relevant to each theme.
Reviewing themes	This involves checking that the themes ‘work’ in relation to both the coded extracts and the full dataset. The researcher should reflect on whether the themes tell a convincing and compelling story about the data and begin to define the nature of each individual theme, and the relationship between the themes. It may be necessary to collapse two themes together or to split a theme into two or more themes, or to discard the candidate themes altogether and begin again the process of theme development.

Defining and naming themes	It requires the researcher to conduct and write a detailed analysis of each theme, identifying the ‘essence’ of each theme and constructing a concise, punchy, and informative name for each theme.
Writing up	Writing-up involves weaving together the analytic narrative and (vivid) data extracts to tell the reader a coherent and persuasive story about the data, and contextualising it in relation to existing literature.

As mentioned earlier, thematic analysis is a robust method of analysing qualitative research data since it allows researchers to report patterns as themes, allowing them to organise and describe a data set in rich detail (Braun & Clarke 2006). While a particular theoretical foundation is not obligatory for conducting thematic analysis, the presence of a theoretical framework becomes necessary to facilitate a comprehensive thematic analysis that surpasses mere description and enables in-depth data examination (Braun & Clark, 2006). Thematic analysis can be done inductively or deductively to identify themes across a data set. An inductive approach implies that themes are derived from the data themselves, not based on the researcher's theoretical framework, and have little relation to the questions asked. In contrast, deductive analysis is more generally driven by theory, allowing for a detailed examination of a particular aspect of the data based on the researcher's theoretical or analytical perspective (Braun & Clark, 2006). In this thesis, I adopted an inductive thematic analysis to comprehend the healthy eating behaviours among pregnant women, which serve as the basic for the intervention development stage of the MRC framework (see Section 3.1). Once the themes have been identified through thematic analysis (TA), I employed suitable behaviour change theories (refer to Section 3.2.2.4.b) to structure and arrange the identified themes.

3.2.2.4.b Tools in behaviour science to understand behaviour: Utilizing COM-B model and Theoretical domains framework for data analysis.

In the present study, behavioural change theories including the Capability, Opportunity, Motivation to Behaviour (COM-B) model and Theoretical Domains Framework (TDF), were exclusively used for the analytical coding frame. These frameworks offer a structured approach to analyse and interpret the data. This section is dedicated to elucidating the reasons

for employing these frameworks to interpret the data and uncovering the barriers and facilitators related to healthy eating and weight gain behaviours among pregnant women in Vietnam.

As addressed in Chapter 2, eating behaviour does not occur in isolation, but as part of a behavioural system in which an individual is affected by a range of cognitive factors, their culture, food beliefs and taboos, their close and extended friends and family, medical professionals, the availability of information sources, and their social situation. The most effective intervention for pregnant women may not only target the woman but also consider other people and factors that may influence the woman's eating behaviour during pregnancy. A comprehensive theoretical understanding of behaviour change can optimize the effectiveness and reach of interventions (Davis et al. 2015). Michie et al. (2008) highlighted that interventions guided by theory have a higher likelihood of generating an impact since they focus on the factors influencing behaviour that can stimulate changes in behaviour. Theory-based interventions showed an effect on a range of lifestyle behaviours including physical activities, smoking, and eating in both pregnant populations and non-pregnant populations (Webb et al. 2010; Bluethmann et al. 2017; Taylor, Connor & Lawton, 2012). Notably, many health interventions are not based on theory, which may lead to an absence or a conflict of effect (Ayers & Olander, 2013; Prestwich et al. 2014). Moreover, the use of theoretical frameworks in evaluating interventions and identifying effective components can enhance our understanding of the underlying mechanisms that drive behavioural change (Pingree et al. 2010). O'Cathain et al. (2019) demonstrated that the initial step in designing behaviour-change interventions involves gaining insight into the specific behaviour that requires modification. Health psychology provides a range of behaviour theories that can be utilized in maternity care interventions, enabling women to make modifications to their lifestyle behaviours, as highlighted by Flannery et al. (2018).

Michie et al. (2011) developed the Capability, Opportunity, Motivation to Behaviour (COM-B) model to provide a theoretical framework for comprehending behaviour in the context. In the COM-B model framework (see Figure 5), three factors influencing behaviour (abbreviated to B) include the "capability" (abbreviated to C) – the physical strength, stamina, skills, and knowledge to make behaviour change, the 'opportunity' (abbreviated to O)- the favourable physical and social environment, accessibility, affordability, acceptability to make behaviour change, and the "motivation" (abbreviated to M)- the feeling of wanting to make behaviour change. Capability can be physical (e.g., strength) or psychological (e.g. knowledge), while opportunity can be social (e.g. social or cultural norms) or physical (e.g.

time, resources). Motivation may be automatic (e.g. urges and impulses) or reflective (e.g. self-conscious planning). The COM-B model may primarily contribute to the development stage of the MRC guidance-based interventions by identifying an evidence-based and/or developing theory (Michie, Atkins & West, 2014). “The COM-B model proposes that for any behaviour to occur a person must have the psychological and physical capability to perform the behaviour; the physical and social opportunity to engage in it and must be motivated to do so”, as highlighted by Flannery et al (2018, p.3). Theoretical domains framework (TDF) maps onto the three central components of the COM-B and can be used alongside the COM-B to facilitate an in-depth understanding of the behaviour (Michie et al. 2005; Cane, O’Connor & Michie, 2012; Michie, Atkins & West, 2014). See Figure 6 for Mapping the TDF constructs to the COM-B. The utilization of the COM-B model and TDF has been employed to investigate behaviour and guide the development of interventions across various health-related behaviours.



Figure 5: The COM-B Model (Michie et al. 2011)

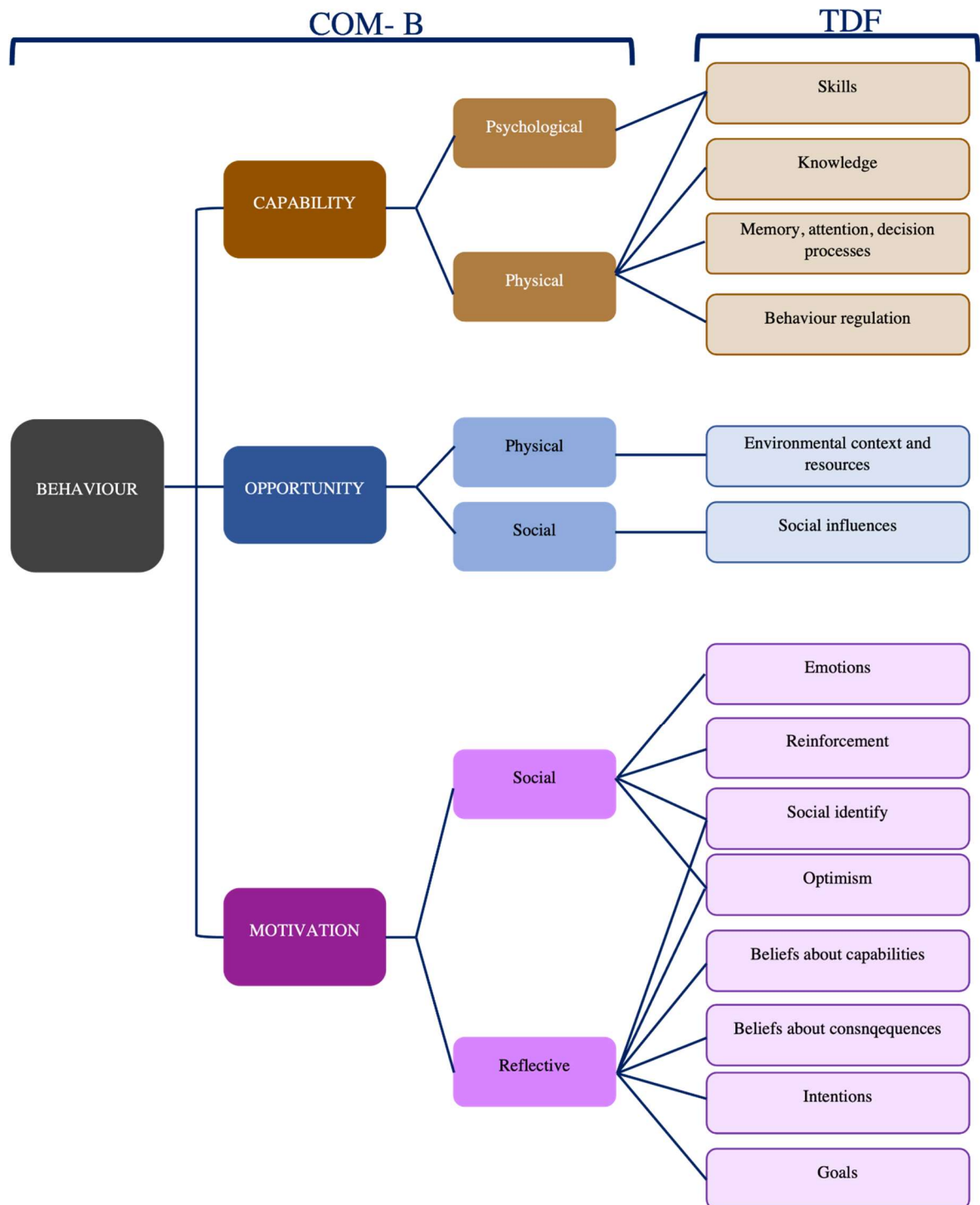


Figure 6: A visual representation of mapping the TDF constructs to the COM-B (adapted from Szinay et al. 2021)

Notably, the COM-B model and TDF have recently been used to identify facilitators and barriers to physical activity and/or eating behaviours among pregnant women in qualitative research (Flannery et al. 2018; Grant et al. 2019, Boyd et al. 2020) as well as in non-pregnant adults (Barker 2016, Timlin et al 2021). To date, some empirical studies have used either the TDF or COM-B to develop behaviour change interventions in different contexts (Alexander

2014, Handley 2016) but to the best of my knowledge, this has not yet been done for eating and weight gain behaviour in a pregnant population in Vietnam.

Therefore, the present study used the TDF and corresponding COM-B model as the analytical coding frame, to recognise barriers and facilitators to healthy eating behaviours in pregnant women and to use this information to inform a logic model for the development of an antenatal eating intervention to improve nutrition among pregnant women in Vietnam.

3.2.2.4.c Procedure of data analysis

Audio recordings were made of the focus group discussions and then translated into English for analysis. NVivo software version 12 was utilized to support data analysis. A thematic analysis (Braun and Clarke 2006; 2019) was employed to analyse the data. An inductive thematic analysis was conducted to identify new emerging themes. These emerging themes were subsequently organized and categorized using the Theoretical Domains Framework (TDF) and COM-B model, as outlined in Section 3.2.2.4. During the process, I thoroughly read and re-read each transcript multiple times to gain a comprehensive understanding of the data.

3.2.2.4.d Data triangulation and Member Checking

Triangulation, commonly known as cross-referencing data, is an important approach for ensuring the quality of qualitative research. It involves the utilization of multiple methods to deepen our comprehension of a specific phenomenon, ultimately leading to more robust and reliable interpretations. According to Mays and Pope (2000), triangulation involves comparing information collected using various data collection methods, such as observations and interviews, or by obtaining data from diverse sources, like conducting interviews with individuals from different interest groups. Using the triangulation approach can help mitigate the risk of research bias that may occur when a study relies on only one data source (Maxwell 2005; Patton 2015). An integral aspect of triangulation involves research participants in the process of member checking. Member checking refers to the practice of returning interview transcripts or analysed data to participants for the purpose of confirming, validating, or assessing the credibility of qualitative findings (Doyle 2007; Birt et al. 2016).

In the current study, I was unable to conduct both triangulation and member checking due to time, resource limitations, and the COVID-19 pandemic. However, I carefully listened and transcribed from the recordings of the focus group discussions during the data analysis to ensure the accuracy of the data. It is crucial to acknowledge the absence of data

triangulation and member checking as a limitation when examining the study's results, given that data cross-checking with research participants was not pursued (see Section 7.3).

3.2.2.5 Patient and Public Involvement and Qualitative Research

There has been a concerted effort to enhance patient and public involvement in health research with the aim of improving the prioritization of research topics, increasing the acceptability of research to participants, and optimizing the quality and dissemination of research outcomes. According to the National Institute for Health and Care Research (NIHR), patient and public involvement (PPI) is defined as “research being carried out ‘with’ or ‘by’ members of the public rather than ‘to’, ‘about’ or ‘for’ them” (NIHR no date, p.3). PPI involves a dynamic collaboration between researchers and individuals from the patient and public sectors. This collaboration actively contributes to the various stages of health research, including its planning, management, design, execution, and dissemination. PPI contributors encompass a diverse group of participants, such as patients, caregivers, service users, the public, and representatives of organizations representing service users (NIHR no date). The input of the public and patients holds a vital role in applied health research, providing an invaluable perspective distinct from that of researchers and healthcare professionals. This unique viewpoint serves to enhance the research's overall design and implementation. Furthermore, the inclusion of patients and the public in research processes serves to bridge the gap between their needs and the research focus, thereby reducing the risk of wasted research resources (Greenhalgh 2019). When research fails to consider the requirements of potential users, such as patients and caregivers, it can result in inefficiencies (Chalmers et al., 2014).

PPI in research offers numerous advantages, including enhancing the clarity and relevance of research materials, improving participant engagement and retention, and promoting more meaningful research outcomes (Shen et al. 2017; Jackson et al. 2020). Additionally, PPI contributes to the effective dissemination of research findings and broadens the pool of research ideas, ultimately leading to resource savings and the overall improvement of research quality (Arumugam et al. 2023). Analysis through systematic reviews consistently demonstrates that the integration of PPI enhances research quality and appropriateness throughout all phases, including inception, planning, execution, and dissemination (Brett et al., 2014). Moreover, PPI has been associated with improved participant recruitment rates, streamlined protocol development, and the selection of relevant and acceptable outcome measures (Domecq et al., 2014). Beyond their role in setting research priorities, patients and the public also play a significant role in offering guidance for research funding. There is a

growing trend among funders to mandate the adoption of PPI standards by researchers, underscoring the importance of involving these stakeholders in the research process (Smits et al. 2020).

PPI and qualitative research are occasionally conflated. Although the methods of engaging with public contributors in PPI and conducting qualitative research may appear similar, their underlying objectives are fundamentally different. In qualitative research, study participants provide data from their lived experiences and perspectives for researchers to interpret and analyse in order to address specific research questions. In contrast, in PPI, individuals go beyond mere participation and become advisors who actively contribute to the research process as part of the research team. They bring the public's perspectives to bear on decisions regarding research priorities, design, relevance, execution, and governance from the inception of the study to its dissemination (NIHR no date). Thus, PPI aims to enhance the design and execution of research rather than providing data to address research questions. Achieving successful PPI in research hinges on the establishment of an equitable partnership between researchers and PPI contributors, highlighting the importance of collaborative decision-making (Renedo et al., 2015). Moreover, it necessitates active engagement with a diverse range of patients and the public, including those from hard-to-reach or underrepresented populations.

Systematic reviews have underscored the widespread application of PPI in qualitative research in the fields of health and social care (Brett et al., 2014; Baldwin et al., 2018). The roles of PPI contributors in qualitative research encompass activities ranging from the early stages, including setting research agendas, and designing the study, to later stages, such as data analysis and report writing (Baldwin et al., 2018). These reviews have also revealed substantial benefits for both PPI contributors and researchers. PPI contributors have experienced psychological and social rewards, as well as opportunities for personal growth, while also assisting others by sharing their experiences in research. Researchers, on the other hand, have improved the quality and suitability of research, lightened their workloads, but encountered challenges associated with demanding workloads, complex interpersonal dynamics, costs, and time constraints (Brett et al., 2014; Baldwin et al., 2018).

In the current study, I consulted with my supervisors, Vietnamese colleagues, and pregnant friends to review my research questions and the discussion guide for focus group sessions, ensuring the applicability and relevance of these questions to pregnant women participants. However, due to time and resource constraints, compounded by the challenges posed by the COVID-19 pandemic, patient and public involvement (PPI) was not feasible in this study. It

is important to note that the absence of PPI integration may pose a limitation that could impact the broad applicability and relevance of the study findings. I am committed to addressing this limitation and intend to explore the integration of PPI in future postdoctoral or research endeavours, recognizing its potential for improving the study's quality and relevance (see Section 7.3).

3.2.2.6 Ethical considerations

Ethical approval for the present study was granted by the General University Ethics Panel at the University of Stirling (No.0656, see Appendix 8). Some ethical considerations in the present study, are described below.

Pregnant women as vulnerable humans

The present study did not include any treatment or therapeutic intervention that affects to research participants and their unborn baby's health. However, unlike non-pregnant counterparts, some pregnant women might have had more stressful periods during their pregnancy. Therefore, it was important to offer them enough time to consider their involvement and consult with their family members or friends regarding the study, and never to try to obtain consent during stressful periods. Moreover, pregnant women may have been vulnerable to more potential psychological issues than their non-pregnant counterparts may. I explicitly conveyed to the participants that if they experienced any discomfort while responding to specific questions during the focus group interviews or any aspect related to the study, they retained the right to decline answering or could choose to contact me via email or phone to provide their response. Furthermore, participants were informed that they had the option to withdraw from the study at any time without providing a reason. It was made clear that their decision to participate or not would not impact the care they received.

Public or private

The Facebook posts used for research recruitment were public to everyone and free to share. The posts provided basic research information and a link to an enrolment site. There had been an ethical concern over whether public Facebook posts affected the privacy of other Facebook users. I advised that Facebook users should not publicly comment or provide any personal contact information about themselves or those they wanted to refer to (e.g., phone or email). I also generally asked those who were interested in the research to use the provided link of an enrolment site to contact me via email or phone for further information or to submit informed consent and questionnaires. The data they provided on the enrolment site was

stored on the University's secure platform, named SharePoint (see Section 3.2.2.7). This site was accessed by only me as the main researcher.

Informed consent

The present study had to be carried out with participants' informed consent (see Appendix 7) because they needed to be fully aware of their participation in the proposed study including how to use the data they provided, their privacy and anonymity, their right to withdraw as well as potential risks. To achieve valid consent, all information about the study and my contact information (i.e., email and phone) were separated from an online enrolment site link. Therefore, this separation encouraged potential participants to read the information or asked questions and had these answered satisfactorily by contacting me via phone and email. As mentioned earlier, upon agreeing to participate in the study, participants were directed to a designated enrolment site through a separate link. At the enrolment site, they were required to provide informed consent by selecting checkboxes, typing their name, and submitting the form. During this process, potential participants had the option to cancel their participation at any time by selecting the "exit" button, in case they wanted to change their mind.

Anonymity

For online focus group discussions, anonymity concerns were similar to face-to-face focus groups. An eligible research participant was anonymised to the public except for other participants and I because online focus groups will be conducted via Messenger Rooms under a private Facebook group with authorisation to join. However, this did not necessarily make them non-identifiable because they might disclose information that made them identifiable to the public. To ensure the privacy of all participants, I requested that each participant maintain respect for others' confidentiality and refrain from sharing any information regarding fellow participants. Furthermore, participants were provided with guidance to ensure their own privacy on Facebook, including recommendations to review and adjust their privacy settings, activate two-step authentication, and apply password protection on any devices used to access the platform.

3.2.2.7 Data storage

At all times I kept all audio files/data collected for the present study on the secure Sharepoint site on password-protected university computers. Sharepoint is a secure cloud storage developed by Microsoft for document management, collaboration, and content management. It provides various security features such as authentication, encryption, auditing, access

control, and secure communication to safeguard data from security threats and unauthorized access. These audio files were destroyed after transcription and translation had been completed. Only anonymised, English language transcripts have been archived for 10 years. The personal data of participants were destroyed at the end of the study.

3.3 Methodology for developing a logic model for interventions targeting healthy eating behaviours for pregnant women in Vietnam.

In healthcare research, logic models have been widely utilized to model complex interventions (Mills et al. 2019). The UK Government's Office for Health Improvement and Disparities (2018) defines a logic model as a visual representation of the theory of how an intervention is intended to work, which demonstrates the underlying theory of change. A theory of change is a conceptual framework that outlines the causal links between the actions implemented in a program and their respective outcomes, demonstrating how they work together to achieve a desired change (Anderson, 2005). Using a cause-and-effect approach, a theory of change enables intervention planners to anticipate the necessary steps and their sequence to bring about the intended change. The development of a logic model is a critical step in designing and evaluating complex interventions (Hayes et al. 2011). The logic model provides a graphic of the theory of change and serves as a roadmap for program planners to identify the resources needed for an intervention, to build understanding and clarity about the intervention, and to evaluate the intervention. Figure 7 present a basic structure of a logic model for an intervention program.

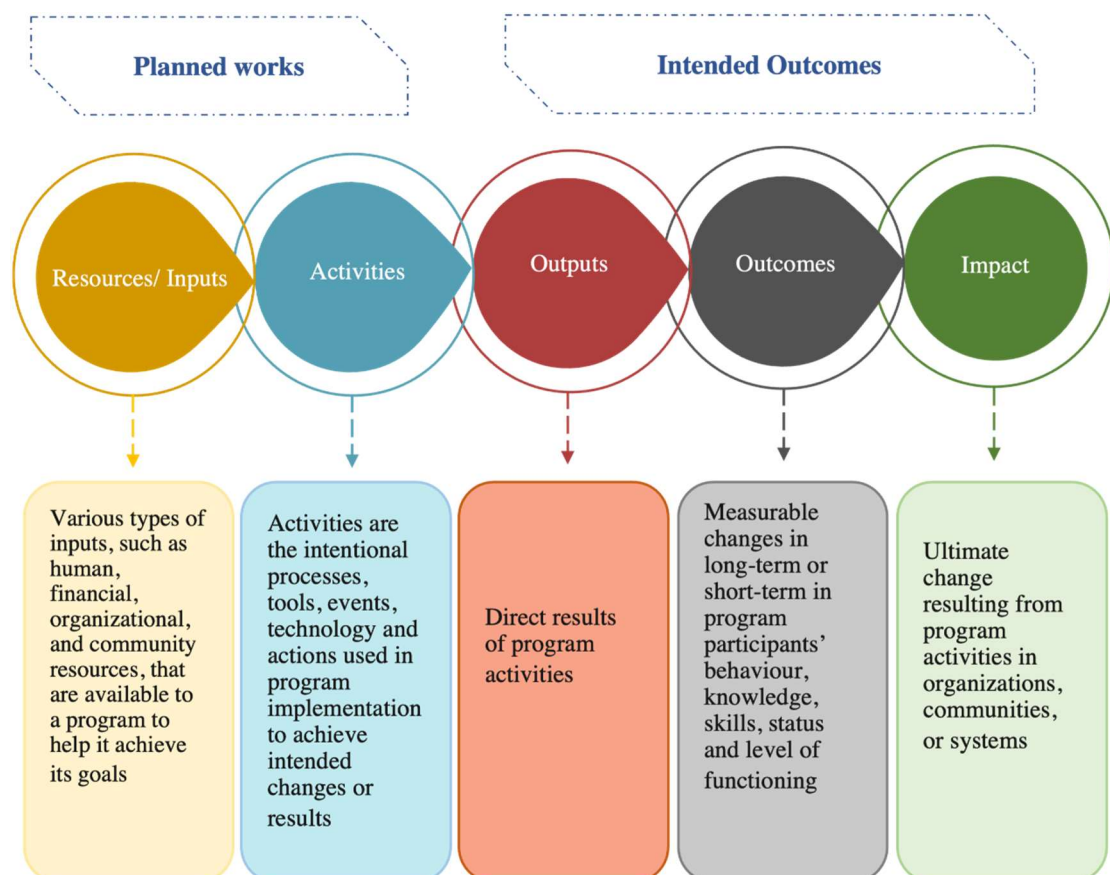


Figure 7: A basic structure of a logic model for an intervention program (adapted from W.K. Kellogg Foundation 2004)

The Scottish Government's 5-step approach for design and evaluation of behaviour change interventions has been utilized to create a logic model for an intervention program aimed at promoting healthy eating behaviours among pregnant women in Vietnam. The 5-step approach is a structured process that guides the development and evaluation of behaviour change interventions. The first step involves identifying the problem or issue that the intervention aims to address, including a clear understanding of the behaviours to be changed and the need to address them at this specific time and place. The second step is to review the existing evidence base and gain an understanding of it to plan the service. The third step is to draw a logic model of how the service should work, detailing the inputs needed to achieve short-, medium-, and long-term outcomes. The fourth step is to identify indicators and collect monitoring data to test whether the intervention worked as predicted. The final step involves evaluating the logic model by analysing the collected data, assessing how well activities were delivered, and whether users' needs were met, or their attitudes changed. Figure 8 illustrates a structured framework, based on the Scottish Government's 5-step approach, for designing a logic model to promote healthy eating behaviours during pregnancy among Vietnamese women through interventions.

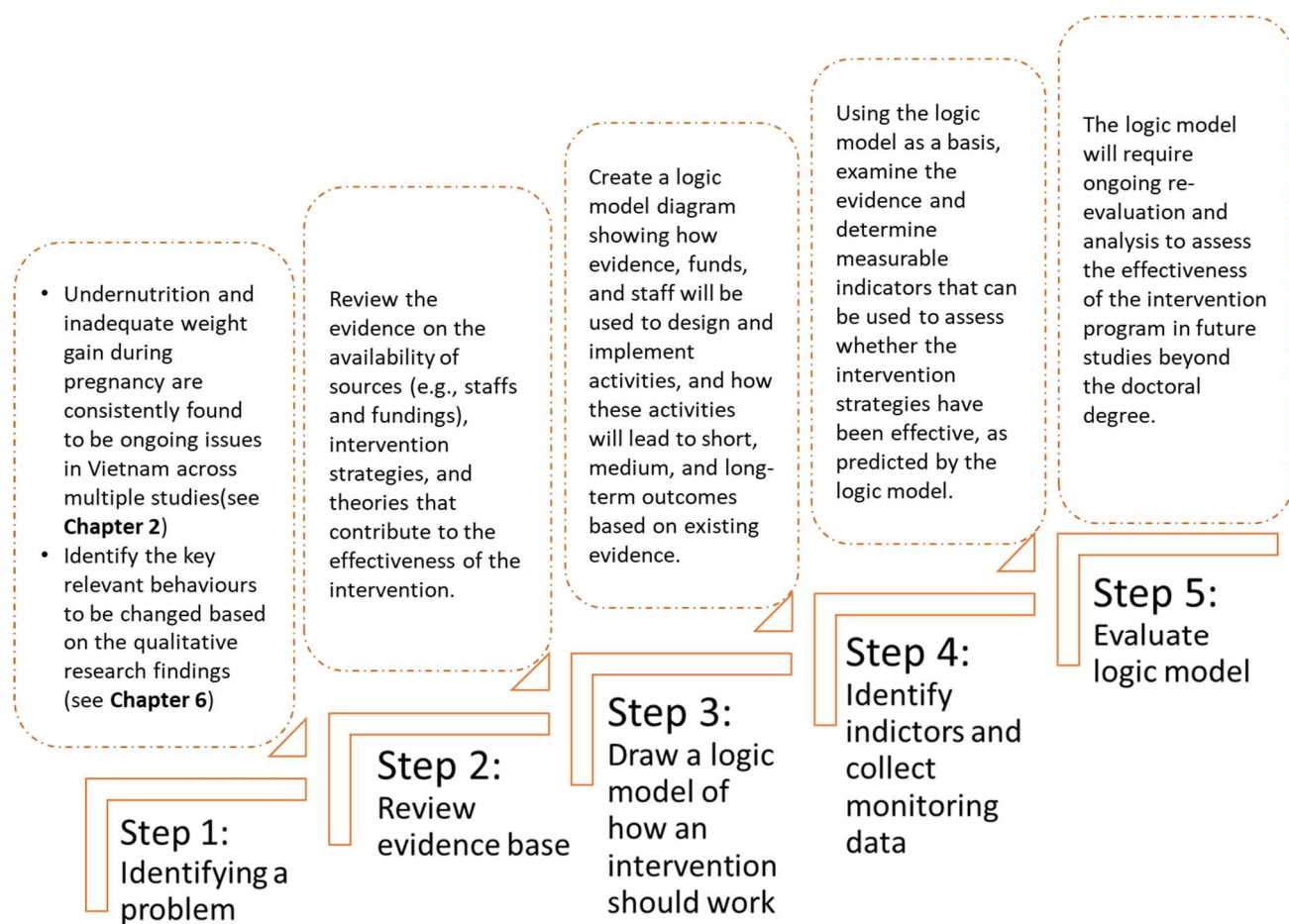


Figure 8: A structured framework on creating a logic model for interventions to promote healthy eating behaviours among pregnant Vietnamese women, based on the Scottish Government's 5-step approach.

3.4 Reflexivity

Olmos-Vega et al. (2022, p.2) defined reflexivity as “a set of continuous, collaborative, and multifaceted practices through which researchers self-consciously critique, appraise, and evaluate how their subjectivity and context influence the research processes”. The concept of reflexivity refers to the way in which a qualitative researcher pays attention to his or her role in the research process (Dowling 2006). This section explores my prior experiences, assumptions, and beliefs that may have affected the research process.

With an evidence-based practice (EBP) underpinning my practice as a nutritional therapy practitioner, I use an integrative approach that is person-centred. Under the EBP framework, it promotes both professional skills and the client’s preference at the heart of the intervention, rather than evidence base alone. Thus, I, as a practitioner, value the diversity of experience that clients bring to my work and the therapeutic relationship is a fundamental part of what I do in clinical consultations. I believe that clients can best tell their own stories about how the world works for them. There may be aspects of the client's experience that were not been aware of, which may be revealed within the therapeutic process. Similarly, participants in research may provide insight into a phenomenon by sharing their experiences. I, as a researcher, also interpret my participants' experiences as part of the research process to develop a deeper understanding of the phenomenon. My approach is similar to that of the therapeutic consultation room, which is to value the participants' experiences while also offering my understanding. I conducted focus group interviews as a data-collecting strategy in this thesis. It was obvious to me that I would have difficulty adjusting to a researcher's role after my consultant role. Unlike the consulting style used in the consultation sessions that summarise and provide advice to patients, the interview style during the research process was a natural way of communicating and was important to engage pregnant women as research participants. This was always brought to my attention before every interview, which I always wrote with the capital letters like “no consultation” in the top head of the interview guidelines.

Throughout the research process, I was intentional in my efforts to uphold the trustworthiness of my study and minimize potential biases. To facilitate this goal, I utilized a self-reflective journal as a tool for documenting my research journey. This practice allowed me to record and analyze my personal feelings, thoughts, beliefs, and challenges that arose during the course of the study. As Thorpe (2010) noted, this type of self-reflection can be a valuable learning process, aiding a researchers in remembering key steps, decisions, and emotions.

One example of this practice in action occurred during focus group interviews, where participants sometimes responded to prompts with a simple "yes." Recognizing that this response did not necessarily indicate agreement but might instead signify attentive listening to others' opinions, I documented this potential source of ambiguity in my journal. This served as a reminder to encourage participants to express their own thoughts and opinions fully. It was crucial to obtain the genuine viewpoints of all participants, as even those who frequently responded with "yes" offered unique and diverse perspectives.

In addition to this example, other potential biases were noted in the journal. For instance, some participants may have felt hesitant to share their thoughts, while others may have dominated the conversation. These potential sources of social desirability bias or groupthink were addressed by actively soliciting input from quieter participants and encouraging more vocal participants to consider alternative perspectives. By implementing these measures, a more diverse range of viewpoints was obtained, enriching the analysis, and understanding of the research topic. Through consistent self-reflection practices, I was able to gain a deeper understanding of my own perspectives and potential biases, which could have influenced my research findings. By acknowledging and addressing these biases, I maintained the credibility of my research and ensured that my findings were objective and accurate.

Russell and Kelly (2002) suggest that reflexivity can be facilitated by examining researchers' individual assumptions and goals, as well as clarifying their belief systems and subjectivities. To ensure the trustworthiness of my work, I kept a self-reflective journal during the data analysis process. I made a conscious effort to avoid forcing the data to fit predetermined labels or answering specific research questions, and I refrained from letting my personal assumptions and life experiences influence the analysis process.

In addition to keeping the self-reflexive journal, I sought guidance from research supervisors to address any concerns or challenges encountered during the research process. For instance, during the first focus group interview with six participants, I found the discussion to be chaotic and frustrating, with multiple people speaking at once. I reminded the participants of the rule that only one person speaks at a time to ensure that all opinions were valued and heard. I discussed this issue with my supervisors to ensure that it did not compromise the quality of the interviews.

Chapter 4: Findings of focus group interviews with pregnant women in Vietnam

Five focus groups (N=20) were conducted between April and November 2021. All focus group discussions were held via Messenger Rooms-based video calls under Facebook private group. Out of the twenty-two eligible pregnant women who agreed to participate in the focus groups and submitted their consent forms, two of them did not attend. One individual changed their mind, while another encountered the difficulty with arranging child care, leading to their inability to participate. Participants' demographic information was summarised in Table 6. The majority of participants were from Hanoi (45%) and Ho Chi Minh (35%). Additionally, most of participants were in their third trimester of pregnancy (65%) and lived in the family home of their husband (60%). A half of participants were first-time mothers-to-be.

Table 6: Participants' demographic information

N (20)	
Age in years, mean (SD)	28 (3.6)
First pregnancy (%)	50%
Residents ▪ Hanoi ▪ Ho Chi Minh ▪ Danang ▪ Others	45% 35% 10% 10%
Trimester of pregnancy (%) ▪ The first trimester ▪ The second trimester ▪ The third trimester	5% 30% 65%
Unintended pregnancy (%)	10%
whom pregnant women live with (%) ▪ Husband only ▪ Husband and the parent of husband ▪ Husband and their own parent	30% 60% 10%
Occupation (%) ▪ Housewife/ unemployed ▪ Self-employed ▪ Employed	25% 20% 55%

The behaviours of Vietnamese pregnant women about healthy eating and weight gain were organised using the COM-B model and TDF. As seen in Table 7, The analysis of focus group discussions identified themes and subthemes of facilitators and barriers in all three aspects of Michie et al. (2014)'s the COM-B model including capabilities, opportunities, and motivations. These themes and subthemes were then laid out in nine out of fourteen domains of Cane et al. (2012)'s theoretical domains framework.

Table 7: Mapping of themes to COM-B model and TDF domain

COM-B Model	Theoretical Domains Framework	Themes	Main points
Capability	Knowledge	Perception of healthy eating and knowledge of nutritional values of foods	Incomplete and limited understanding of healthy eating and food sources. Preferred taking supplements rather than incorporating into to diet.
		Knowledge of food safety	Pregnant women demonstrated awareness of the importance of food safety during pregnancy; however, their understanding was incomplete.
		Knowledge of gestational weight, nutrition, and calories for the baby	A misconception about gestational weight gain, focusing more on calories for the baby and the post-pregnancy body rather than understanding the importance of appropriate weight gain during pregnancy.
		Knowledge of gestational diabetes mellitus prevention (GDM)	Misconception regarding the relationship between sugar and carbohydrate intake and GDM due to limited

			understanding of carbohydrate sources.
	Skills	Self-reliance and self-care	Women displayed the high level of self-care and independence to make informed choices for themselves and their babies, highlighting their active engagement in managing their health during pregnancy.
		Skills on online searching	Skilled in using various online resources to find information.
	Memory, Attention, Decision making processes.	No data	None
	Behavioural regulation	No data	None
Opportunity	Context & Resources	Information seeking behaviour and the use of the internet and Facebook.	Women found the internet and social media more available and accessible to information. Notably, women are proactive in seeking out information related to their health and are eager to make informed decisions through various channels, with a particular emphasis on social media groups, especially on Facebook. This proactive behaviour indicates that the women are receptive to the idea of receiving nutritional advice or education, as they have already shown a willingness to seek out this

			type of information on their own
		Lack of reliability and the dangers of misinformation on the internet and social media	Pregnant women commonly turned to Google and social media for information, while expressing reluctance to access official websites of health organizations or government departments due to concerns that the information provided was generic and not regularly updated. However, the reliability of online sources varied.
		Value and Trustworthiness of Information Sources for Pregnant Women	The trustworthiness of information sources can vary and may be influenced by pregnant women's social networks.
	Social influences	Healthcare providers	Lacking communications between doctors and women
		Supports from female family members and male partners.	Benefiting from the supports of experienced female relatives regarding family matters and maternal nutrition, although some of their advice may be outdated. Insufficient communication and understanding from male partners during pregnancy were common concerns for pregnant women.
		Social media networks: Facebook	It emphasised that the importance of connection with other women's experience to seek reassurance from the experiences of others as well as seeking information to make their own decision-

			making through social media Facebook.
		Food cultures and taboos	The Chinese belief in the harmony and balance of hot and cold elements, as well as food taboos, is prevalent and can prevent pregnant women from following various diets. Women held a belief in a direct cause-and-effect relationship between specific food consumption and the wellbeing of their unborn baby. The effects of beliefs are varied. Thus, it is important to consider these cultural beliefs and food taboos when making dietary recommendations. It is important to consider cultural beliefs and food taboos when making dietary recommendations.
Motivations	Emotions	Fear of phytoestrogen-rich foods among pregnant women carry a male foetus	The integration of food beliefs with nutrition science can result in worry among women who lack a comprehensive understanding. Although certain foods are sources of phytoestrogens, misinformation obtained from social media or a misunderstanding that consuming these foods does not determine the sex of their baby can lead to the misapplication of knowledge, further compounding concerns.
		Fears and Concerns Regarding Prenatal Supplements: Public vs. Private Doctors	Women's fears were evident concerning the quality of prenatal supplements prescribed by public doctors in contrast to private doctors,

			as well as anxieties surrounding over-prescription and the potential for adverse side effects.
		Feelings of shame or distress when being unable to control food cravings.	Pregnant women experienced shame regarding their food cravings when they felt they were not meeting societal expectations concerning pregnancy and weight gain.
	Intentions	Intentional approach of pregnant women towards their eating habits during pregnancy	Pregnant women demonstrate a conscious decision to act in specific ways regarding their eating habits, driven by concerns for their own health and the well-being of their unborn child. However, their reluctance to change their eating behaviours pose challenges in promoting healthier dietary practices during pregnancy.
	Beliefs about capabilities	Confidence in managing morning sickness symptoms.	While women perceived morning sickness symptoms as a necessary sign of pregnancy in the first trimester, they often became confused and lacked confidence in managing these prolonged symptoms and modifying their diet accordingly.
		Confidences in weight management during pregnancy	Low confidence in weight management during pregnancy.
	Beliefs of consequences	Belief of prenatal vitamins and dietary supplements	Micronutrient supplement adherence varied among women, with perceived curative benefits associated with adherence.

	Social Identity	Belief in "mommy transitions" Women's role and responsibility identity at home	Women were motivated by their role as mother-to-be but were more likely to feel ashamed if they did not meet social and personal expectations
		Confidence in managing morning sickness symptoms.	While women perceived morning sickness symptoms as a necessary sign of pregnancy in the first trimester, they often became confused and lacked confidence in managing these prolonged symptoms and modifying their diet accordingly.
	Reinforcement	No data	None
	Goal	No data	None
	Optimism	No data	None

4.1 Capabilities

According to the definition of the COM-B model, Michie et al. (2014, p.19) described capabilities as “the psychological and physical abilities to perform a behaviour and includes knowledge and skills”.

The analysis of the focus group discussions related to this component have revealed Vietnamese women’s knowledge and perceptions of healthy eating and weight gain during pregnancy as well as their ability to seek nutrition-related information online. According to the Theoretical Domains Framework (TDF), this component has been laid out in two domains including knowledge and skills.

4.1.1 Knowledge

Cane et al. (2012, p.13) defined the knowledge within the TDF as ‘an awareness of the existence of something’ which includes the knowledge of the condition, knowledge related to methods or procedures, and knowledge of task environment.

The analysis of focus group discussions with Vietnamese pregnant women revealed that they demonstrated knowledge on a range of topics related to healthy eating behaviours, including healthy eating habits, the nutritional value of different food groups, appropriate gestational weight gain, weight management strategies, awareness about the role of nutrition in preventing gestational diabetes, and the importance of food safety during pregnancy. Moreover, the study presented their skills in seeking information related to nutrition during pregnancy on the internet. These findings were discussed in detail in subsequent sections.

4.1.1.1 Perception of healthy eating and knowledge of nutritional values of foods

Through the analysis of the focus group discussions with pregnant Vietnamese women, it became evident that their understanding of the crucial role nutrition and food play in providing essential minerals and vitamins during pregnancy was incomplete and varied. With regards to food groups, the participants unanimously acknowledged the importance of consuming fruits and vegetables for promoting a healthy pregnancy.

“Now I try to eat a variety of vegetables. Indeed, I had only eaten a few veggies including cucumber, carrot, and tomato before. I particularly don’t like leaf vegetables, but I now force myself to eat them [...] I only need to eat them for my baby within several months, so I encourage myself to eat them.” (Group 3)

Some participants also thought of adopting healthier eating behaviour when pregnant because they were holding a misconception of eating for two, for their unborn baby and

themselves. To gain this, they increased their intake of protein as well as engaged in taking vitamins and dietary supplements.

“You know! I must eat for my baby. Thus, I need to eat a lot more protein than I normally do and take calcium and iron supplement for my baby as well.” (Group 1)

In addition, participants acknowledged the importance of micronutrients, but their awareness of specific sources of micronutrients was limited, and many failed to recognize that these minerals and vitamins can be found in various foods. For example, participants identified sources of key micronutrients such as folic acid in nuts and vitamin C in oranges and guavas, but demonstrated limited knowledge of other foods that contained these nutrients.

“I know that folic acid is important for the baby's development, and I heard it's in some nuts. So, I tried eating peanuts. But honestly, I didn't really know what else had it. I just thought nuts were the main source.” (Group 2)

The participants were familiar with iron supplements but demonstrated limited understanding of the presence of iron in food sources. Even though the participants were familiar with iron supplements, they displayed a limited understanding of the critical role that iron plays in maintaining a healthy pregnancy.

“I am not sure why the iron supplement is given.” (Group 1)

Despite acknowledging the importance of micronutrients in maintaining a healthy pregnancy, the analysis of the focus groups discussions revealed the participants relied predominantly on supplements instead of incorporating micronutrient-rich foods into their daily diet.

“I could not eat anything in my first trimester, but I didn't try to eat. I thought my baby only needed iron and calcium enough in this period, so I only took these supplements instead.” (Group 4)

Taken together, based on the analysis of focus group discussions, it was evident that there exists a requirement for increased education and awareness about the role and diversity of a nutritious diet during pregnancy, encompassing sources of critical vitamins and minerals, among Vietnamese pregnant women.

4.1.1.2 Knowledge of gestational diabetes mellitus prevention (GDM)

In addition to their knowledge of a healthy diet during pregnancy, the analysis of focus group discussions revealed that despite being healthy, non-diabetic pregnant women, most

participants held a misconception about the relationship between sugar and carbohydrate intake and the risk of developing gestational diabetes mellitus (GDM), which led to the avoidance of certain foods. For example, some participants avoided or limited certain foods such as sugar, fruits, and rice during their pregnancy to prevent the risk of developing GDM because they failed to distinguish between sugar and other types of carbohydrates. Some fruits were thought as a sugary food and were avoided to prevent GDM, when in fact, fruits are an important source of vitamins and micronutrients for pregnant women.

“I was really worried about getting diabetes during pregnancy, so I stopped eating fruits like bananas and mangoes because I thought they were full of sugar. I didn't want to risk it. I also reduced my rice intake.” (Group 2)

Additionally, a few women in the focus groups also held a misconception that the frequency of consuming some amounts of certain food (e.g., seafood) could put them at the possible risk of GDM. As noted by one participant

“I much prefer to eat seafood, but I wondered if or not seafood causes gestational diabetes. However, I should eat it in moderation as well.” (Group 4)

Furthermore, the participants demonstrated a limited understanding of GDM, including its diagnosis, what its health risk, and who is at risk of developing the condition. While most participants were able to identify common signs of GDM such as tiredness, disordered sleep, and excessive thirst, only one participant correctly noted that a blood test is the best way to diagnose GDM.

“There are other symptoms such as disordered sleep, excessive thirst and more, but I think a test is the best way to know whether you are diabetic.” (Group 5)

When participant further talked about who may be at the increased risk of GDM, most participants said that women who gain weight or consume sugars too much during pregnancy are more likely to develop GDM. However, few participants identified additional factors such as a family history of GDM and a previous history of GDM.

“If they [women] had gestational diabetes with the first child, they are more likely to get it in the second pregnancy.” (Group 5)

Participants also exhibited a limited understanding of the management of GDM if diagnosed with the condition. Only one participant correctly noted the importance of nutrition and lifestyle modifications in managing GDM.

“Having gestational diabetes, the first thing you should do is to change your diet. Because you are getting pregnant, you cannot do regularly heavy exercises. Instead, you should do gentle exercise for about 150 minutes a week. The diet should be divided into multiple meals, 5 or 6 meals, a little bit each meal. Consuming sweets as little as possible, eating less starch and foods that are made from rice, and eating more green vegetables and protein-rich sources.” (Group 5)

In a nutshell, the analysis of focus group discussions revealed that participants held a misconception regarding the relationship between sugar and carbohydrate intake and GDM due to limited understanding of carbohydrate sources. This may prevent pregnant women from consuming a diverse range of nutritious foods. The analysis also showed that participants’ knowledge about the prevention and management of the GDM was incomplete. Therefore, increased education and awareness are needed about the role of carbohydrate intake during pregnancy, including information on food sources.

4.1.1.3 Knowledge of food safety

Ensuring food safety is an important aspect of maintaining a healthy pregnancy in addition to a balanced diet, as discussed in Chapter 2. An analysis of the focus group discussions with Vietnamese pregnant women revealed that a mere half of the participants possessed knowledge of and adhered to food safety practices during pregnancy. Most participants avoided raw foods such as sushi and salads, as well as pickled foods.

“I only avoid eating sushi and salad. Because it is uncooked. Raw vegetables can pick up germs, which is not safe for my baby. These vegetables in the uncooked or raw state can bother my baby’s stomach as well.” (Group 3)

Among the participants, a single individual accurately recognized the risk associated with parasitic diseases transmitted by consuming snails.

“I heard that the disease that affects women’s womb makes the women miscarriage. The disease is transmitted by several snails that are found in the water.” (Group 1)

Despite being aware of the potential risk, this woman decided to consume it, but in a moderate amount and cook it carefully.

“Anyways, I still eat them, but I cook a little more carefully. I have also read that eating snails may treat many diseases, even jaundice. I’m not completely against eating snails, but I only ate less and added shrimp, crab, and fish which also have

calcium. I usually prepare snails at home and avoid eating snail dishes in street-side vendors.” (Group 1)

Like this woman, many participants also consumed snails. They only stopped eating snails when they experienced food poisoning symptoms.

“During pregnancy, I ate a lot of seafood, but I didn't eat snails. I experienced food poisoning symptoms such as abdominal cramps, diarrhoea or vomiting after eating a snail dish.” (Group 5)

During the analysis of focus group discussions, Vietnamese pregnant women also shared their perspectives on food quality and location. Some participants believed that the quality of food in rural areas was better than in urban areas, with one participant stating, *"foods which are farmed in the countryside are fresher than ones in the city"* (Group 4). This perception may be influenced by concerns about food safety and hygiene in urban markets.

In addition, one pregnant participant expressed concern about the quality of food in urban markets, stating, *"I'm afraid of the poor food quality during the storage, so I often buy shrimp and crabs that are still alive."* This concern highlights the potential for food spoilage and contamination in urban markets. The participant went on to explain that *"dead fish have been stored with urea to look fresh"* (Group 5), highlighting the use of chemical preservatives.

In brief, the analysis of focus group discussions with Vietnamese pregnant women highlighted that while some participants had knowledge of and adhered to food safety practices during pregnancy, there were gaps in their understanding. Avoidance of raw and pickled foods was common, but only one participant recognized the risk associated with consuming snails. Snail consumption was prevalent, and participants stopped only after experiencing food poisoning symptoms. Concerns about food quality in urban markets and the use of chemical preservatives were also expressed. These findings underscore the need for comprehensive education and guidance on food safety during pregnancy and access to safe and nutritious food sources.

4.1.1.4 Knowledge of gestational weight gain, nutrition, and calories for the baby

During our focus group discussions, pregnant women demonstrated an understanding of the importance of gaining weight during pregnancy, but they lacked clarity on the specific amount. Participants were unaware of the appropriate weight gain that based on their prenatal BMI. Most participants noted that 10-12 kilos of weight gain during pregnancy are

optimal although they self-reported themselves as overweight or underweight. It is noteworthy that this amount of weight gain is for those who have healthy prenatal BMI. As one participant shared,

“I don’t want to gain weight too much. I think no more than 10 kilos is okay [...] my body is more prone to being overweight than others [...]” (Group 3)

The analysis from the focus groups revealed that pregnant women expressed uncertainty regarding the appropriate amount of weight they should aim to gain during pregnancy. Notably, these women held the expectation of gaining a similar amount of weight as they did in their previous pregnancy.

“My body looks thin, and it can be very difficult for us to get body fat anyways. If you ask me, I just want to gain the same weight as my previous pregnancy, about 12 kilos, to get my baby to have a healthy weight at birth like my first son.” (Group 5)

When asked about how to gain weight during pregnancy, participants focused on foods that were associated with weight gain rather than a plan or a goal. Some participants were aware of not gaining weight too much because they struggled to return to their pre-pregnancy weight in their previous pregnancy.

“I gained 16 kilos. I don’t want to gain so much weight. I used to gain 25 kilos in my previous pregnancy, then it’s difficult to lose weight afterwards. Indeed, I did not return to a normal weight yet before having this baby. Thus, I put more and more weight on this baby. I think it’s about extra 10 kilos. My body is kind of more likely to gain weight. I have recently visited my doctor; she said the baby is quite large. She advised me not to eat high-carb foods and consume more vegetables.” (Group 3)

In conclusion, the focus group discussions revealed that pregnant women expressed uncertainty about the appropriate amount of weight to gain during pregnancy. They generally aimed for a weight gain of 10-12 kilograms, irrespective of their prenatal weight status. Participants emphasized the importance of a healthy gestational gain weight but lacked specific guidance on how to achieve it. They tended to focus on specific foods associated with weight gain rather than having a comprehensive plan. The findings highlight the need for clear and personalized advice from healthcare providers regarding appropriate weight gain during pregnancy, considering individual factors such as prenatal BMI and previous pregnancy experiences.

4.1.2 Skills

Under the TDF's definition, Cane et al. (2012, p.13) described skills as 'an ability or proficiency acquired through practice'. The authors went into detail on the list of constructs of skills including "skills, the development of skills, competence, ability, interpersonal skills, practice". Within this domain, analysis of the focus groups with Vietnamese pregnant women revealed their proactive approach to self-care and their ability to seek information from various online sources.

4.1.2.1 Self-reliance and self-care

The women who participated in the focus groups exhibited a remarkable level of self-care and independence when it came to managing their health and seeking out information. They actively took charge of their own well-being and sought out reliable information to make informed decisions. Their autonomy was evident in their proactive approach towards seeking health-related information and their determination to make informed choices for themselves and their pregnancies. This demonstrated a strong sense of self-efficacy and a willingness to take ownership of their health and well-being during pregnancy. One participant shared,

"I prefer to research things on my own before making a decision. I think it's important to have accurate information, especially during pregnancy." (Group 2)

Pregnant women were so motivated to gather accurate information about their health that they even conducted their own research. They recognized the significance of acquiring reliable information and were willing to invest time and effort to ensure that they had access to the right resources. As one participant described, she had experienced discomfort after eating and sought advice from her doctor and friends. However, when the advice did not work, she turned to social media groups for support. The woman shared as below.

"One day I don't chew foods carefully, and right then my body feels hot. I also asked my doctor and my friends for advice. They advised me to drink more water, but it did not help a lot. I've recently found that I'm not alone with these symptoms. There are a few groups of pregnant women like me on Facebook sharing their experiences and solutions. They suggested me divide my meals into smaller meals, like 5-7 meals a day, as well as chewing food and eating slowly while eating. For me, it significantly relieves these symptoms." (Group 5)

In brief, the findings showed the high level of self-care and independence reflects the participants' ability to make informed choices for themselves and their babies, highlighting their active engagement in managing their health during pregnancy.

4.1.2.2 Skills in online searching

Analysis of the focus group discussions revealed that many pregnant women searched for nutrition information online, with the majority expressing confidence in using Google as their primary search engine. These women demonstrated basic skills in locating information from a variety of online sources, including the websites of local health departments and social media platforms.

However, while the internet provided numerous opportunities for pregnant women to seek information about nutrition and diet, it also presented challenges, particularly regarding the reliability of the information available (see Section 4.2.1.2). Participants in the focus groups expressed concerns about the difficulty of understanding the information they retrieved while searching on the internet. As one participant (Group 5) noted, searching online can lead to an "*information maze*". This difficulty may be influenced by factors such as education background and health literacy level. Nevertheless, some participants employed different strategies to comprehend the retrieved information, such as seeking help from others. As one participant suggested:

"I'm more likely to go to Google and type my question. If I didn't find my answer, I used "Hello Doctor" which is a doctor hub. I can request a question on this page and get an answer from a doctor afterwards." (Group 3),

4.2. Opportunity

According to the definition of the COM-B model, Michie et al. (2014, p.19) described opportunities as "all factors that are external to an individual that may influence engagement with an activity, ranging from the physical environments in which people spend time to the social and cultural milieu that dictates how we perceive and think about particular activities."

Focus group discussions relating to this component revealed environmental factors related to Vietnamese women's life during pregnancy as well as the importance of culture and its influences on women's behaviours. Thus, this component was framed into two domains of TDF including environmental context and resources, and social influences.

4.2.1 Environmental context and resources

According to the TDF's definition, Cane et al. (2012, p.14) described environmental context and resources as "any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour". This encompasses elements such as available resources, an individual's interaction with their surroundings, facilitators, barriers, and environmental stressors.

Within this theme, the focus groups shed light on the significance of information sources and seeking behaviour among pregnant women, highlighting the prevalence of online platforms such as Google, websites, and social media as the primary sources of knowledge on food during pregnancy. While these sources play a crucial role in helping women navigate pregnancy diets, the discussions also revealed potential disadvantages associated with online information. Additionally, books were identified as another valued source of nutrition-related information for pregnant women.

4.2.1.1 Information seeking behaviour and the use of the internet and Facebook.

Pregnancy is a moment that gave participants rise to thinking of and seeking information concerning nutrition. As mentioned early in Section 4.1.2.1, women often relied on themselves to search nutrition and supplement information and make decisions. Information-seeking behaviour among pregnant women was mainly reinforced via the Internet or social media. They found the internet and social media more available and accessible to locate immediately at least a solution to their nutrition-related issues.

"I always turn to the internet and social media whenever I have nutrition-related questions during pregnancy. It's just so convenient and readily available. I can quickly find solutions or answers to my concerns without having to wait or rely on other sources." (Group 3)

The analysis of focus group discussions with pregnant women in Vietnam also revealed that the participants actively sought out information on nutrition through various channels, with a particular emphasis on social media groups, especially on Facebook. Women displayed a proactive attitude by actively seeking information about their nutritional requirements during pregnancy. They utilized online platforms, particularly Facebook groups, as valuable sources of information.

"I go to Facebook to see other mothers' experiences [...] I often have a chat with friends on Facebook about nutrition information I've read to hear their opinion, particularly those who experienced on the same thing." (Group 4)

These findings suggest that the pregnant women in Vietnam are proactive in seeking out information related to their health and are eager to make informed decisions. This proactive behaviour indicates that the women are receptive to the idea of receiving nutritional advice or education, as they have already shown a willingness to seek out this type of information on their own. Furthermore, it also emphasized the growing role of social media in shaping information-seeking behaviours among pregnant women in Vietnam and the increasing

reliance on online sources for health-related information. Thus, future interventions focused on nutritional education or advice are highly likely to be well received by these women, given their proactive nature and reliance on digital platforms for information.

4.2.1.2 Lack of reliability and the dangers of misinformation on the internet and social media

The analysis from the focus group discussions found that pregnant women expressed reluctance to access official websites of health organizations or government departments for pregnancy-related information for reasons such as the websites not appearing on the first pages of Google, being user-unfriendly, providing generic information, and not being regularly updated. As one participant (Group 5) noted, *"Information about pregnancy nutrition on these websites often provides generic knowledge"*. This underscores the limitations of generic nutrition information from official sources and highlights the importance of personalized approaches to nutrition during pregnancy. There may be a need for these organizations to improve the accessibility, user-friendliness, and quality of information provided on their websites to better meet the needs of pregnant women seeking information on nutrition and diet during pregnancy.

Furthermore, concerns were also raised about the reliability of online information sources. The focus group discussions revealed that pregnant women did not completely believe in everything on the internet. Because of concerns about lacking authenticity in sources, they were bombarded with information that they were unable to understand. This could give pregnant women confusion rather than a satisfying answer. It suggests that although the Internet searching was widely used, one of the difficulties recognised within the focus groups is an inability to judge how the retrieved information is qualified and accurate.

"You also have to be very careful about information online because it may make you more anxious. Like I suddenly had itchy palms and feet in the first months of the pregnancy. I searched Google. Everything I read about it is serious and the things I need to do is to do a variety of medical tests like a blood test and a muscle-related test that I could not remember its name. I got worried about it and I could not concentrate on my teaching throughout the days until I asked my friend who is a doctor for advice." (Group 5)

One of the challenges in obtaining reliable nutrition-related information for pregnant women is the phenomenon of circular reporting, where one source publishes information that is then picked up and spread by other news outlets. This creates difficulty for pregnant women in

assessing the authenticity and credibility of the information they come across. As one participant highlighted, this situation adds to the confusion and uncertainty surrounding nutrition advice during pregnancy.

“I love drinking soya milk. Since my doctor said that my baby is male, I’m afraid of drinking soya milk too much can alternative my baby’s gender. Then I searched for this in many pages and groups on Facebook. Almost all pages said that it’s okay to drink soya milk under 0.5L per day, but I felt that the information only came from one resource. I hoped to read about alternative ideas as well.” (Group 1)

Furthermore, pregnant women face challenges in determining the reliability of nutritional information when there is inconsistency among various sources. This inconsistency leads to difficulties in trusting the accuracy of the information provided and makes it challenging to crosscheck the quality and validity of the information received. This adds to the confusion and uncertainty experienced by pregnant women when seeking reliable nutritional guidance.

“Fish is good for the baby’s brain development, but some people recommended not consuming fish because they may contain mercury. This chemical is toxic to the baby’s brain. That’s why I said searching Google can lead you to an “information maze”. (Group 5)

Through the analysis of the focus group discussions, it was also revealed that pregnant women have raised concerns regarding the authenticity of information found online. Participants emphasized the importance of verifying the credentials of the authors who provided or shared the information. During the discussions, some women highlighted the significance of verifying the credibility of authors by confirming their real-life healthcare professional status or through platform verification, such as "green sticker" Facebook verification. As one participant noted,

“Facebook could be fascinating and frightening at the same time. I often avoid reading health-related information unless it is vetted by a doctor, a nutritionist or a person I knew is a genius. I also follow the pages of the hospitals [...] They [geniuses] have a green sticker on their profile. I often cross-reference information between couples of sites where possible in order to ensure they were almost saying the same thing [...] I think pages of experts [Facebook page] particularly nutritionists are genius to get diet information. Their post is cited from scientific sources although I never check these sources. Lol. I often go by their pages first to

check the information because I trust the information that they've shared. You can comment on their post. If be lucky enough, they can reply to you.” (Group 4)

However, assessing the professional background of a source or an individual is not always a straightforward task for pregnant women. As a result, participants in the study also relied on platforms or individuals that had demonstrated positive outcomes in addressing their diet-related concerns. This subjective evaluation of reliability highlights the importance of personal experiences and outcomes in shaping pregnant women's perceptions of trustworthy sources of nutritional information.

Participant (group 1): “I guess an admin of the Facebook group “the Mother 4.0” is also a doctor.”

Interviewer: “Why do you think that?”

Participant (group 1): “Her profile picture looks professional, and I don't know, but her posts or comments are effective to me. I have recently been constipated. My mom said that I should drink much more water. I did, but it's not working at least for me. She posted drinking coconut water can ease constipation. So, I drank a glass of coconut water a day. I don't know, but I now frequently pass stools.”

The focus group discussions revealed further apprehensions regarding the impact of commercial activities on platforms like Facebook, specifically regarding potential biased information. Participants emphasized the need for vigilance when encountering pages that promote commercial products and have monetary motives. The importance of critically evaluating the information was emphasized as participants acknowledged the dual nature of Facebook, which can offer comfort but also pose potential risks. They stressed the need to consider the credibility of the source and take into account the experiences of others. One participant pointed out,

“Facebook can comfort, and they can hurt. Therefore, I always give it a thought... on information I read to know who experienced an issue like me or who took advance from me.” (Group 3)

Taken together, the analysis of the focus groups revealed several significant findings regarding the information-seeking behaviours of pregnant women. Firstly, there was a reluctance among participants to access official websites of health organizations or government departments for pregnancy-related information due to various reasons such as generic and outdated content, poor website design, and infrequent updates. This highlighted

the limitations of generic information from official sources and the need for personalized approaches to nutrition during pregnancy. Additionally, concerns were raised about the reliability of online information sources, with participants expressing scepticism and difficulty in discerning accurate and trustworthy information. The circular reporting of nutrition-related news and inconsistent information from different sources contributed to confusion and doubts among pregnant women. Authenticating the credibility of online sources and identifying trustworthy authors were seen as crucial factors in determining the reliability of information. Social media platforms, particularly Facebook, played a dual role as both a source of fascination and anxiety. Pregnant women sought information from pages vetted by healthcare professionals or individuals considered as experts, while also recognizing the potential for biased information driven by commercial activities. Cross-referencing information and seeking confirmation from professionals emerged as strategies to ensure the reliability of online information. Overall, these findings underscore the challenges faced by pregnant women in navigating the vast amount of information available online and emphasize the importance of improving the accessibility, quality, and credibility of online resources to meet the specific needs of pregnant women seeking reliable nutrition information during pregnancy.

4.2.1.3 Value and trustworthiness of information sources for pregnant women

The analysis of the focus group discussions highlighted the value of books as a source of nutrition-related information for first-time pregnant women. However, it's important to recognize that the trustworthiness of information sources can vary and may be influenced by recommendations from family members, friends on social media or information found on the internet. The analysis in the subsequent section highlights that women are often swayed by these factors (see Section 4.2.2). It is important to be aware of this and encourage women to critically evaluate any sources of information they use to ensure that they are evidence-based and accurate. This can help pregnant women feel empowered to make informed decisions about their health and the health of their babies.

“I also buy and read books regarding nutrition during pregnancy. Some information I find in the books is clearer and more useful than resources online [...] It’s about weight gain during pregnancy. On the internet, we most find that a woman should gain 10-12 kilos in total. For me, this information seems to be “copied” from one source and circulated on almost all pages and websites. However, I’m not sure that the 10-12 kilos are exactly the same for all women in different shapes. Like me, I look very thin. The book I read said that I should gain 12-16 kilos because I’m kind of

underweight. I think things written in the book are trustworthy although many people including my friends recommended me not to gain too much.” (Group 1)

4.2.2 Social influences

Within the definition of the TDF, Cane et al. (2012, p.14) described social influences as ‘interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours’ including social norms, social comparisons, modelling, social support, and social pressure.

The focus group discussions revolved around the various individuals and entities that pregnant women interacted with, including healthcare providers, family members, their male partner, and social media networks, with a particular emphasis on Facebook. These interactions were found to have the potential to either hinder or motivate their eating behaviours. Additionally, this section explored the influence of culture on the acceptance or rejection of certain foods by pregnant women.

4.2.2.1 Healthcare providers

Analysis of the focus group discussions with Vietnamese pregnant women found that pregnant women identified nutrition as an essential part of prenatal care and doctor as trusted sources of information. Pregnant women expressed a desire for more detailed guidance on nutrition and diet from their doctors, as well as recommendations for reliable sources of information online. As one participant mentioned,

“A doctor is always the best person to reach out to for health-related issues, but for me, nutritional concerns are not enough to say it once. The doctor said everything, but they didn’t ask me what I eat and told me what I should not eat.” (Group 5)

However, despite their desire for the information provided by doctors, it was found that many participants expressed frustration with the lack of specific nutrition information provided by their doctors or other healthcare professionals. One participant stated,

“At 4 months pregnant, I sometimes experienced belly bloat after I eat certain foods. The symptom was worse as frequently as part of my meals. I asked my doctor about my symptoms, but she promptly replied to me that “it’s okay”. She seemed to be so busy that she could not wait for me to describe all symptoms I suffered. I also wanted to ask her whether the foods I was eating is related to my symptoms because my husband thought that I ate spoiled food. However, I didn’t have any chance to ask

her any further questions. She said that it is normal, but I thought that there was something wrong.” (Group 5)

This viewpoint was expressed by multiple participants during the focus group interviews. The shared sentiment was that doctors were too busy to provide detailed information about nutrition and diet.

“My doctor only went over my symptoms, and she seemed to so busy to listen to me. While I was explaining why I was concerned about vitamin D, the doctor jumped in with all vitamins and supplements that were already prescribed, and then I was redirected.” (Group 4)

In addition, it was also found that leaflets and brochures containing information on diet and nutrition were often distributed to pregnant women during antenatal consultations without adequate discussion or assessment of understanding. The analysis of the focus group discussion revealed that such an approach was not effective in influencing decision-making as many women reported that they were less likely to read these resources. As highlighted by one participant

“My doctor seemed not to give me a specific or direct answer to my question. Last month I was so stressed that I didn’t feel hungry. Swallowing food made me nauseous. I asked my doctor for help, but she quickly replied to me “okay, you know the baby will be getting all it needs”. Then she showed me a booklet with a food pyramid and said “you should consume like this” Blah, blah. I knew I should eat, but I just couldn’t. You know! the doctor has just bombarded with a must-eat list, that’s all.” (Group 5)

These findings underscore the importance of supplementing written information with discussion and interaction with healthcare professionals, in order to maximize the effectiveness of the resources. Therefore, healthcare professionals should ensure that they engage in meaningful discussions with pregnant women and assess their level of understanding to support informed decision-making.

Taken together, the focus group discussions with Vietnamese pregnant women revealed a discrepancy between the participants' desire for detailed nutrition information and the limited guidance provided by healthcare professionals. Despite the participants' trust in healthcare professionals as a source of information, the time constraints and lack of specific guidance they received left them feeling uncertain about their nutrition choices. The study

highlights the need for improved communication between healthcare professionals and pregnant women, with a focus on providing detailed and personalized guidance on nutrition and diet. By addressing these issues, healthcare professionals can better support pregnant women in making informed decisions about their health and the health of their babies.

4.2.2.2 Supports from female family members and male partners.

Within the social circle of pregnant women, recommendations regarding nutrition often came from female members on both sides of their family, including their mother and sister. These suggestions were often based on personal experience or hearsay. Women tended to question the accuracy of information from older female family members, including their own mother or their husband's mother, perceiving them as outdated.

"My mother-in-law gave me a lot of advice about pregnancy, but I often doubted it. She means well, but I think times have changed, and some of the things she suggested seemed outdated. I often read up on it online." (Group 1)

Conversely, they considered their sisters as reliable sources if they could witness their sister's pregnancy as a positive and successful experience.

"I've switched to a multivitamin since the second trimester. My sister bought this multivitamin for me. She also only took it when getting pregnant. Her baby born at an ideal weight (about 3.8 kilos) was very healthy." (Group 5)

On the other hand, being told what to do by family members caused stress for pregnant women, as expressed by one participant, who felt annoyed with her sister's frequent suggestions about what she should eat during pregnancy.

"I have heard about eating for a baby quite regularly from my sister. It made me annoyed. You know, if you're craving it, it means you want it. If not, I could not eat it." (Group 1)

While the physical support provided by male partner, such as cooking and assisting with household chores, was acknowledged, women frequently encountered a lack of communication and understanding from their male partner regarding their pregnancy and nutrition needs. One participant reported an instance where her husband dismissed or trivialized her concerns about nutrition issues, making it challenging for her to maintain a healthy diet. This absence of communications and the needs left the women feeling unsupported.

"I often experience constipation, and it becomes quite uncomfortable and frustrating. It's really frustrating when my husband completely dismissed my concerns and he often brushed off my worries, thinking I was exaggerated or unnecessary. I tried explaining him how it was affecting my comfort and well-being, but he didn't take it seriously. It made me feel unheard and unsupported during this important time of my pregnancy." (Group 2)

Overall, the findings shed light on the influential role of family members, particularly female relatives, in providing nutrition recommendations to pregnant women. While suggestions from sisters were valued and considered reliable, suggestions from older female family members were often perceived as outdated and questioned. Moreover, the study revealed that being constantly told what to do by family members, especially sisters, caused stress and annoyance among pregnant women. The lack of communication and understanding from male partners regarding pregnancy and nutrition needs further compounded the challenges faced by women. Dismissive attitudes from husbands regarding the nutritional issues of pregnant women were particularly evident. This left women feeling unsupported and unheard during this crucial time. These findings emphasize the importance of effective communication, support, and a collaborative approach between family members, particularly male partners, to ensure the well-being and nutrition of pregnant women.

4.2.2.3 Social media networks: Facebook

Interpersonal exchanges, both online and in real life, played a significant role in enhancing pregnant women's information-seeking behaviour. As mentioned earlier in Section 4.2.1.1, Facebook, the online community, served as valuable sources of information. Pregnant women were open to accepting new ideas about nutrition or food recipes from peers they connected with on the internet and social media, such as Facebook. They also found comfort in stories or experiences shared by other mothers in Facebook groups, which helped them navigate the challenges of pregnancy with greater ease.

"I am also a member of a Facebook group of over 10k moms to talk and get together for baby issues [...] When I visit a doctor, I sometimes would like him to talk about the pros and the cons as well as how I can benefit from certain supplements. I found these groups more comfortable to address these issues [...] If I have a question associated with my pregnancy issues, I went round these groups and I could find myself in their cases and knew how they resolved it [...] I can learn from other moms' experiences. These groups provide me with a safe opportunity to engage with and

discuss with my peers about my pregnancy issues. In these terms, it is very helpful too!” (Group 3)

In addition, women in the focus groups highlighted the importance of seeking reassurance from the experiences of other women when searching for information. They emphasized the value of connecting with other women's experiences, as it can be reassuring and provide a sense of support. As one participant stated, she was more likely to share or talk to other women about her experiences to seek comfort in the experiences of other women who are in similar situations.

“I sometimes experienced belly bloat after I eat certain foods [...] I thought that there was something wrong. I went online to find an answer for myself. In Facebook groups, some women’s symptoms were similar to what I had. They said that the body during pregnancy may be sensitive to some foods such as tomatoes, oranges and bread that cause bloating. I found that I also had these foods in my meals, so I stopped eating them and the symptoms got better.” (Group 5)

It was interesting to note that the significance of community and connection with other women in the process of seeking information. While it was presented earlier that women found comfort in sharing their own experiences of others and hearing from others, in this case, the emphasis was on women utilizing the experiences of others as a tool to inform their own research and decision-making.

An important finding from the analysis of the focus groups was that virtual communities offered pregnant women the chance to broaden their social circles and develop new friendships in offline settings. These online communities provided a platform for connecting with other individuals who shared similar experiences and interests. By engaging in virtual interactions and participating in group activities, participants were able to establish meaningful connections that extended beyond the digital realm. This aspect of virtual communities proved to be valuable in expanding social networks and fostering new friendships in real-life contexts.

“[...] I join a Facebook group where women of Ho Chi Minh and its surrounding towns can connect with other moms by attending fun social get-togethers, or just make a friendship. This is a group for supporting each other, growing and new friendships. [...]” (Group 3)

In brief, the findings emphasised that the importance of connection with other women's experience to seek reassurance from the experiences of others as well as seeking information to make their own decision-making.

4.2.2.4 Food cultures and taboos

As mentioned earlier in Chapter 2, the Chinese's belief in the harmony of the body, which is kept balanced by the opposite forces of yin and yang, influenced the Vietnamese cuisine. Yin is considered as the quality of being "cold", which includes leaf vegetables and fruits while yang is the aspect of being "hot", which consists of fatty foods, salts, chilis, and red meats. The classifications of hot or cold foods refer to the beliefs about how these foods affect the body once consumed. Consumption of hot foods can increase the heat of the body. In contrast, intake of cold foods can make the body colder. Thus, maintaining an equilibrium between the forces of 'hot' and 'cold' is essential in preventing the onset of a specific disease. (Xiong et al. 2021).

The analysis of the focus group discussions found that many pregnant women reported a belief in Chinese medicine that the balance of hot and cold elements in their diet can be important during pregnancy. According to this belief, cold and hot foods can have certain effects on the body, such as causing poor blood circulation in the uterus or constipation. However, there is little scientific evidence to support this belief, and it may be based more on anecdotal experiences and beliefs passed down through generations. Pregnant women might hear about this belief from friends or family members and tried it out themselves, even if they were not entirely sure of its effectiveness. As one participant described her experience about this belief.

"I still remember an unpleasant experience I suffered after eating a bowl of katuk soup at 2 months pregnant. My mom cooked it because she did not know about it before. I was getting a pain in my lower abdomen after eating it. Although the pain was mild, I was getting rather worried about what was wrong with my baby. I could not sleep until I met my doctor the next day." (Group 5)

It was noted that this belief persists. Many pregnant women in the focus groups integrated it into their pregnancy's diet. They reported foods that were labelled as "cold" and "hot" that were avoided in the first trimester and the third trimester, respectively. Most of the cold foods were vegetables (e.g., katuk, mung bean) and some fruits (e.g., unripe papaya, watermelon and bitter melon) while fried foods were hot.

“Cool foods” such as katuk, mung bean, and mostly green vegetables are not good for our pregnancy because these foods can induce “poor” blood circulation in the uterus [...] I just would add some cool fruits such as unripe papaya, watermelon and banana. They are associated with miscarriage or bleeding if we eat them during the first 3 months.” (Group 5)

The first trimester is considered as a “cold and weak” state due to “cold” pregnancy hormones, so hot foods are acceptable. However, very hot foods like chili and alcohol are not advised due to risk of miscarriages (Manderson 1981; Dang et al 2021).

Some participants reported that the introduction of cold foods in this state can make the mother and the baby colder and weaker. As a result, participants strictly followed avoidance of cold foods in the first trimester because of a fear of prolonging the mother's weakness or causing a miscarriage. Hot foods were restricted in the third trimester for those whose body is weaker or more sensitive.

“Generally speaking, I avoid cold foods for the first months. If you are too kind of person who is sensitive to these foods, you also should avoid hot foods. Fortunately, I’m kind of easy eater. [...] If you are “strong” enough, you are okay. However, if you are not enough strong, you will have a miscarriage. [...] It [“strong”] means that someone is easy to eat and don’t experience any morning sickness. You should avoid it for the three first months, and then you can eat what you like.” (Group 2)

Additionally, pregnant women perceived their second trimester as a neutral or safe state. For most participants, it’s safe for enjoying all foods which they desire or could not eat before.

“I completely don't eat katuk and green papaya in the first three months, but now it's the second trimester, I also begin eating green papaya again. I like to cook green papaya soup with pork bones. This soup is especially nutritious, particularly for pregnant women like us.” (Group 5)

This was documented in a previous report by Manderson et al (1981) suggesting “hot” foods such as pork are recommended in the first trimester for providing energy and supporting the development of the foetus, whereas cold foods such as mung bean, coconut, spinach, melon, and green papaya are avoided. Notably, the Latin American and Caribbean believed that the whole pregnancy was considered a quite warm period because of the heat resulting from the accumulation of blood that is not routinely disposed of every month, as well as from the heat released by the developing foetus (Vásquez-Londoño et al. 2021). Maintaining the warmth

of the pregnancy is important to keep the foetus healthy until giving birth. Thus, pregnant women need to avoid eating cold foods. But eating too much hot food, like spicy, salty, or fatty foods, is believed to have negative effects on the baby's blood circulation, harm the developing organs, and even potentially cause delays in deliveries (Ormsby 2021; Cantor 2016).

In addition, pregnant women in Vietnam demonstrated a strong belief in a cause-and-effect relationship between specific food consumption and the wellbeing of their unborn baby. They attributed the concept of beauty and ugliness in their unborn baby to certain foods, perceiving them as influential factors. The attribution of symbolic meaning to foods exists in Vietnamese society and it varies culture-by culture and person by person. This process might act as a barrier or facilitator to women's eating behaviour in during pregnancy. Many participants attached the beauty conception to drinking coconut water or sugarcane juice while they attribute the ugliness of conception to drinking cola or eating guava. For example, some women endorsed this:

“Drinking coke too much during pregnancy, baby's skin will be rough” (Group 2)

The analysis of the focus group discussions revealed that taking coconut water during pregnancy was a common practice among pregnant women. Participants shared that they believed coconut water had several benefits, including making the amniotic fluid purer and improving the baby's skin condition at birth although there is no scientific evidence to support these. Moreover, participants noted that societal beauty standards, such as desiring a fair-looking baby, could influence their food choices during pregnancy. For instance, one participant mentioned that drinking coconut water could result in a fair-looking baby.

“I drank a glass of coconut water a day [...] In Vietnam, you know and many people want babies to be fair looking, not dark looking. It's thought that if you drink coconut water then your baby's going to be fair looking.” (Group 1)

These findings suggest that cultural beliefs and societal expectations could play a significant role in shaping pregnant women's dietary choices. Healthcare providers should be aware of these beliefs to provide appropriate guidance to pregnant women.

Participants in this study also believed that consuming organ meats contributed to the intelligence and well-being of their unborn children. Notably, pork stomach was seen as a representation of a healthy digestive system for the unborn child, while pork brain was

associated with future intellectual capabilities. Therefore, these expectant mothers incorporated these meats into their diets throughout pregnancy. As one participant noted,

“It is said that eating a pig’s stomach in pregnancy can make my baby’s digestive system healthier in later life. I think it’s quite right, so I started eating it from 32 weeks pregnancy. I had also eaten it when I was carrying my first boy. His digestive tract is quite good because he rarely has diarrhoea or certain digestive disorders.”
(Group 3)

When inquired about healthy foods for pregnant women, each participant had their own list to contribute. Interestingly, the foods they deemed highly beneficial were frequently associated with higher costs or originated from foreign sources rather than being commonly consumed. Among the top recommendations for a healthy pregnancy, they mentioned edible bird's nest (a nest made from the saliva of specific types of swiftlets), walnuts, and almonds.

“Being pregnant with my first child, I ate walnuts. As a result, my son is quite smart. He can remember a picture as quickly as I show him. It’s a reason I also want to eat walnuts for this pregnancy. However, I cannot eat it due to the morning sickness. Tasting it left me with a feeling of nausea [...] I’m afraid that this baby is not as smart as his brother because I’m not eating walnuts or getting enough other nutritious foods during this period.” (Group 4)

Taken together, the analysis of the focus groups underscored the significant influence of cultural beliefs and food taboos on the dietary practices of pregnant women in Vietnam. The participants demonstrated a strong adherence to the concept of balance between hot and cold elements in their diet, as influenced by Chinese medicine principles. These beliefs led to the avoidance of "cold" foods in the first trimester and "hot" foods in the third trimester, driven by concerns about miscarriage, blood circulation, constipation, and potential harm to the baby. In addition, these women firmly believed in a cause-and-effect connection between their food intake and the well-being of their baby. They assigned subjective meanings to foods, linking them to ideas of beauty, intelligence, and digestive health for their unborn child. For instance, drinking coconut water was believed to result in a fair-looking baby, while consuming organ meats like pork stomach was associated with a healthy digestive system. Despite the absence of scientific validation for these beliefs, they profoundly shaped the food preferences and choices of pregnant women. It is imperative for healthcare providers to acknowledge and address these cultural beliefs to offer suitable guidance and support regarding nutrition during pregnancy.

4.3 Motivations

Motivation refers to mental processes that energise and direct behaviour. It includes both automatic processes involving “emotions and impulses” and reflective processes including “evaluations and plans” (Michie et al. 2014, p.10). The focus group discussions revealed emotional factors including the fears and stresses of Vietnamese women during their pregnancy. Moreover, reflective motivation including pregnant women’s beliefs during pregnancy and an identity of role as mothering have been uncovered. Thus, this component has been framed into the TDF’s domains including emotions, beliefs about capabilities, intentions, social identity, and beliefs about consequences.

4.3.1 Emotion

According to the TDF’s definition, Cane et al. (2012, p.14) described emotion as ‘a complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event’ including fear, anxiety, stress, positive or negative affect and depression.

The matter of foetal health is a highly emotive issue for pregnant women where focus group discussions insight into emotions such as fears and stresses. These types of emotions might present as barriers to their dietary behaviours during pregnancy.

4.3.1.1 Fear of phytoestrogen-rich foods among pregnant women carrying a male foetus

Women often incorporate their food beliefs into nutrition science, but the lack of a complete understanding can lead to worries. Soybean and soybean-related products like tofu and soya milk are rich sources of phytoestrogens. Consumed these foods, the phytoestrogens are commonly identified in the amniotic fluid and blood of women and fetuses during pregnancy as previously reported (Foster et al. 2002; Jarrell et al. 2012). Thus, it is widely thought phytoestrogens have the same effect in the body as oestrogen and could contribute to the disruption of the developing male foetus if consumed phytoestrogen-rich foods. However, to date, there is no evidence for a link (Hamilton-Reeves et al. 2010, Messina 2010, Domínguez-López et al. 2020). Although certain foods contain phytoestrogens, applying this knowledge incorrectly due to misinformation from social media or misunderstanding that the consumption of these foods does not affect the sex of their baby can exacerbate worries. Many pregnant women in the focus group discussions, who are carrying a male foetus, are strongly concerned about a substantial oestrogenic effect which could contribute to the disruption of the developing male foetus if they consume phytoestrogen-rich foods (e.g., soya milk and tofu) in significant quantities.

"I've heard mixed opinions about soy, but I didn't want to take chances with my baby's health. So, I decided to avoid soy products like tofu and soy milk while I'm pregnant with a boy." (Group 3)

This fear may be driven by the inconsistency of information sources about phytoestrogen-rich foods.

"Everything I search about soya milk keeps inconsistent. Some websites said that soya milk is okay to drink while others said that pregnant women should not drink it." (Group 5)

The analysis of the focus group discussions discovered that the fear mentioned above is greatly impacted by the prevalence of son preferences within Vietnamese households. This finding was exemplified by a participant, who expressed her refusal to consume soya milk. She provided a comprehensive explanation outlining her reasons for not including it in her diet.

"Last week a page said that soya milk is good for pregnancy. It's wrong and I don't drink soya milk from being pregnant because it can harm reproductive organs and change the baby's gender, particularly boys." (Group 2)

Although revealing the sex of an unborn baby is officially prohibited during prenatal visits in Vietnam, it is noteworthy that many Vietnamese mothers are aware of the sex of their children before birth. This is because ultrasound scans in antenatal care are readily available and accessible, allowing mothers to find out the sex of their baby (Gammeltoft and Nguyen 2007; Edvardsson et al. 2015). Son preferences, which have been noted by anthropological studies and demographic surveys, still exist in many Vietnamese families; this phenomenon is found to be related to the prevalence of more traditional patrilineal systems in Vietnam. (Valentine & Christophe 2013). Thus, pregnant women, who carrying a son, had a strong pressure to avoid any foods that they thought could "change" their son's gender during pregnancy.

"I'm carrying a boy, so I completely avoided eating soya milk and tofu since the beginning of my pregnancy. Moreover, I ate more bananas and rice in the mornings to make sure to bear a "straight" boy. I just want to have a healthy child with his proper gender." (Group 3)

The insights derived from the analysis of the focus groups shed light on the participants' profound worries about maintaining their well-being throughout pregnancy. Beyond

ensuring their baby's health, they expressed specific concerns about gender-related characteristics, particularly those that could potentially impact a boy's fertility in the future. These concerns showcased the depth of their anxieties and the complex considerations they held during this crucial period.

“Others said that eating tofu during pregnancy can affect my unborn baby’s gender. I’m not sure how true it is but I am having a boy. I could never live with myself if my unborn baby had an error that could be caused by something I have eaten, so I should have avoided it. I miss the food too much but there will be much time to enjoy it when the baby arrives.” (Group 4)

4.3.1.2 Fears and concerns regarding prenatal supplements: public vs. private doctors

During a focus group discussion, it was revealed that some pregnant women in Vietnam have a pervasive fear that vitamins and dietary supplements prescribed by public doctors may not be as qualified as those prescribed by private doctors. One participant shared that while some people recommended a range of supplements for pregnancy, they trusted their private doctor who prescribed iron, calcium, and DHA supplements from the first day of their pregnancy to the present. The participant did not experience any negative side effects from the supplements prescribed by their private doctor, but she noted that her colleagues who took supplements from the public hospital experienced hot flashes, acne, and worsened facial skin.

“Some people also recommend me a range of supplements for pregnancy, but I trust my doctor [a private doctor]. He prescribes iron, calcium, and DHA. I take them from the first day of my pregnancy to now, but I don’t feel “hot”. My colleagues who take supplement from the hospital are hot. [...] Well, they got acnes and their facial skin becomes worse. It [supplement from the hospital] is cheaper, I think.” (Group 2)

It is unclear whether the quality of the supplements or the expertise of the doctors prescribing them is the cause of these negative side effects. Interestingly, the participant mentioned that the supplements from the hospital are cheaper, suggesting that cost may also play a role in the decision-making process of pregnant women regarding their choice of supplements.

In addition, some participants in our focus group discussions expressed fear of over-prescription of unnecessary supplements in public hospitals. As a result, they skipped taking vitamins that were prescribed of being the fear of overdosing on their foetus. This may be

driven by low trust in doctors in the public sector. A participant's descriptions of justifications for explaining this.

"I believe it depends on the private or public hospitals. For me, there are two types of doctors: a "bad" doctor and a "good" doctor. Unfortunately, I met both. A "bad" doctor is that a doctor prescribes you many things including calcium, iron, omega-3s, etc. because they profit from prescribing supplements. A "good" doctor is that a doctor, who is rich or has a high salary, prescribe iron and calcium, or sometimes multivitamins. If you go to a private hospital, you are more likely to meet the latter, compared to public hospitals." (Group 3)

In this context, the terms "bad doctor" and "good doctor" were further clarified by Nguyen et al. (2017), who highlighted that the prescribers in many public hospitals in Vietnam received payments from pharmaceutical companies. The authors explained that doctors in the private sector found it more advantageous to establish a strong reputation to attract patients rather than accepting inducements and risking the loss of patients. This approach ensured a sustainable income as patients naturally gravitated towards higher-quality providers, leading to the elimination of poor-quality practitioners. However, unlike the private sector, public hospitals lacked an automated system of accountability and were consistently overcrowded. Prescribers in public hospitals continued to receive their government salary regardless of their performance, indicating a lack of consequences for subpar healthcare delivery.

In conclusion, the analysis of the focus groups revealed concerns among pregnant women in Vietnam regarding the quality of prenatal vitamin and dietary supplements prescribed by public doctors compared to private doctors. Negative side effects reported by those taking supplements from the public hospital raised questions about their quality and the expertise of the doctors. Fear of over-prescription were additional factors influencing women's choices. The distinction between "bad doctors" and "good doctors" highlighted the presence of financial incentives in public hospitals, potentially affecting healthcare quality. These findings emphasize the importance of quality control and trust in the healthcare system, particularly in public hospitals, to address the concerns of pregnant women regarding supplement use during pregnancy.

4.3.1.3 Feelings of shame or distress when being unable to control food cravings.

The analysis of the focus group discussions revealed divergent attitudes among pregnant women towards food cravings during pregnancy. Sweet foods and salty foods are common

kinds of foods craved by participants. Some women saw their cravings as a way for their body to communicate what their baby needed.

“I drink Milo, a chocolate-flavoured malted powder [...] I felt like my appetite changed during pregnancy start. My baby could cause these changes. She wants me to eat what she wants.” (Group 4)

On the other hand, some women in our study expressed concern about their cravings, with some feeling guilty or ashamed about them.

“I’m aware of this [food cravings] although I also struggle to control my eating. Sometimes I feel ashamed after eating and promise that I never do such eating again. I stop eating late for some days, but then it turns into my normal habit. I think it depends on how much willpower we have on that bad habit.” (Group 3)

Pregnant women may feel like they are not meeting societal expectations related to pregnancy and weight gain if they indulge in their cravings or gain excess weight in relation to cravings. There was also a belief among some women that cravings for unhealthy or "junk" foods reflect poor self-control or lack of willpower, which can exacerbate feelings of shame and guilt.

“I found myself craving sugar since getting pregnant. I don’t know the reason why I am easy to put so much weight on. My baby is gaining weight so fast as well [...] I feel that my eating habits are unhealthy. That said, I should eat at mealtimes, but I often feel like I have little control over my eating. I eat whatever I want, whenever I want it. My eating habit seems to be illogical. That’s why I’m getting more fat.” (Group 3)

In a nutshell, pregnant women had divergent attitudes towards food cravings during pregnancy. Some saw cravings as their body's way of communicating their baby's needs, while others felt guilty or ashamed about their cravings. Indulging in cravings and potential weight gain can lead to feelings of not meeting societal expectations, exacerbating shame and guilt. These findings highlight the complex dynamics surrounding food cravings in pregnancy.

4.3.2 Intentions

4.3.2.1 Intentional approach of pregnant women towards their eating habits during pregnancy

According to the TDF's definition, Cane et al. (2012, p.14) described intentions as a 'conscious decision to perform or resolve to act in a certain way'.

Pregnant women consciously make decisions and resolve to act in specific ways when it comes to their eating habits, driven by concerns about personal health, weight, body image, and the well-being of their unborn child. These considerations prompt them to adopt a variety of deliberate eating strategies, which include the intentional distinction between consuming food for the benefit of the foetus and addressing their own nutritional needs. By making these conscious choices, they strive to ensure optimal health for themselves and their baby, demonstrating a proactive approach to their dietary practices during pregnancy.

Pregnant women in the focus group discussions considered their foetus as 'an active participant' apart from their body system including food preferences. This could act as a barrier and facilitator to healthy eating behaviour among pregnant women. As a result, women commonly reported that they eat what their foetus wants them to eat, or they avoid a certain food because their foetus does not want it.

"I routinely drink milk formula before bedtime; I feel like my baby love drinking it too. You know, my baby moves a lot once I drink a glass of hot milk formula. It seems that he gets more energetic." (Group 1)

When ultrasound scan is widely used in Vietnam, most pregnant women in our focus group discussions could know their estimated foetal weight. When it comes to gestational weight gain, women also perceived the foetus as "an active participant" apart from themselves, so they intended to select or consume foods or nutritious products which help the foetus gain weight, but not for the mother's weight. In Vietnam, commercial milk products are available to pregnant women, including whole cow milk and milk formulas. Whole cow milk may be sold with or without added sugar. Milk formulas for pregnant women, on the other hand, commonly consist of milk powder fortified with vitamins, minerals, and DHA, which are mainly marketed as nutritional supplements for pregnant women to support foetal and infant development (Nguyen et al. 2021). These milk formulas are promoted as a convenient option to ensure sufficient nutrient intake during pregnancy in Vietnam.

The analysis of focus groups revealed that pregnant women held a belief that consuming cow milk without sugar could potentially increase amniotic fluid levels. Additionally, they

expressed a belief that commercial milk formulas led to weight gain for the mother, while non-sugar cow milk or cereal-based milk resulted in weight gain for the foetus. As noted by one participant

“You know, I drink cow milk as much as water [...] Drinking non-sugar cow milk makes the foetus gain weight as well as increase amniotic fluid. I experienced a lack of amniotic fluid in my first child. At that time, I drank milk formula.” (Group 2)

These beliefs were primarily based on the participants' personal experiences of estimating foetal weight and monitoring amniotic fluid volume during ultrasound visits. It is important to note that while these beliefs were derived from personal experiences, scientific evidence supporting these claims is currently lacking. The use of advanced ultrasound technology allowed pregnant women to track their foetus's estimated weight gain and assess amniotic fluid volume during each ultrasound visit.

In addition, it also highlighted an important finding from the focus groups, indicating that pregnant women expressed a lack of interest in making changes to their eating behaviours, which they attributed to being a result of human nature. Essentially, they denied the existence of a problem and showed reluctance to take any action towards making changes. Pregnant women who struggled to control their food intake or manage their weight during pregnancy experienced feelings of self-blame and guilt, believing that they were solely responsible for their perceived failures. One participant (Group 2) acknowledged her uncontrolled eating habits, stating, *"I'm a kind of easy eater compared with others,"* while another participant (Group 3) recognized her predisposition to gain weight, stating, *"I think my body is kind of more likely to get fat."* These findings emphasised the participants' self-perception and the challenges they faced in accepting responsibility for their eating behaviours during pregnancy.

In brief, pregnant women make conscious decisions and take deliberate actions regarding their eating habits, driven by concerns for their health and the well-being of their baby. Beliefs about the foetus as an active participant in food preferences and the effects of cow milk and commercial milk formulas on weight gain exist. However, scientific evidence supporting these beliefs is lacking. Some pregnant women express a lack of interest in changing their eating behaviours, facing challenges in accepting responsibility for their habits during pregnancy.

4.3.3 Beliefs about capabilities

According to the TDF's definition, Cane et al. (2012, p.13) described beliefs about capabilities as 'acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use' including self-confidence, self-esteem, empowerment, and perceived behavioural control.

Within this domain, focus group discussions focused on pregnant women's confidence in making modifications to their diet for morning sickness symptoms as well as their own experiences of trying to manage their weight.

4.3.3.1 Confidences of morning sickness symptoms

Most of the participants experienced morning sickness symptoms such as nausea and vomiting. It is worth noting that these experiences are widely prevalent during pregnancy, affecting up to 80% of pregnant women worldwide (Lee, 2011). These symptoms happened throughout their day, not in a specific pattern, but they became worse when women consumed food. A clear confirmation from participants in the focus group discussions is that they perceived the symptoms of morning sickness as a must-have sign of pregnancy in the first trimester, so they were well-prepared for this event by dietary modifications to relieve these symptoms of morning sickness.

"From the beginning to four months of pregnancy, I consumed very little because of the morning sickness, so I tried to eat anything that does not make me feel sick."

(Group 5)

Those, who did not have the symptoms during their pregnancy, are considered as lucky or special. A conversation among participants (Group 5) reinforced this.

Participant 1: *"my diet is as normal as usual: three meals a day because I didn't have any symptoms of morning sickness. Until now, I don't have any issues with eating."*

Participant 2: *"You're so lucky, TA. From the beginning to four months pregnant, I consumed very little because of the morning sickness, so I tried to eat anything that does not make me feel sick. After the period of morning sickness, my eating became a little better."*

Participant 3: *"Yes, me too. From the first to the third month, I also had morning sickness, so I ate less than usual."*

However, pregnant women did not expect and were unprepared to deal with prolonged symptoms, so they became confused and unconfident to manage these prolonged symptoms as well as modify their diet.

“Some people said that morning sickness usually clears up by week 12 of your pregnancy, but I still have it until now [...] I believe I will feel better if I pass the 12 weeks of pregnancy. Honestly, I always expect to pass the 12 weeks of pregnancy every day. So disappointed! I’m still having symptoms now. I don’t know when the symptoms completely clear up.” (Group 4)

In summary, morning sickness symptoms such as nausea and vomiting are widespread among pregnant women. These symptoms occur throughout the day and worsen after consuming food. Participants in the focus group discussions considered morning sickness a common sign of early pregnancy and made dietary changes to alleviate the symptoms. However, prolonged symptoms beyond the expected timeframe left the women confused and lacking confidence in managing them. They expressed disappointment and a desire for the symptoms to resolve. Further research and support are needed to address the challenges faced by pregnant women dealing with prolonged morning sickness symptoms, providing them with better information and resources for effective management.

4.3.3.2 Confidence in weight management during pregnancy

The analysis of the focus group discussions unveiled the factors that affect women's confidence in managing their weight during pregnancy. The inadequate knowledge surrounding weight management during pregnancy, as discussed in Section 4.1.1.4, undermined the confidence levels of pregnant women in effectively managing their gestational weight. This finding was consistent among first-time pregnant women. However, participants who had prior childbirth experiences and successful postpartum weight management exhibited confidence in managing their weight during pregnancy. One participant highlighted how her confidence in managing weight during her current pregnancy increased after successfully implementing a weight loss plan following her previous pregnancy.

“I put on 20 kg during my first pregnancy. At 2 weeks postpartum, I was at 68 Kg weight but certainly not my pre-pregnancy shape (54 Kg). However, since doing Yoga, I lost 7 Kg, I was not in any hurry, but I was looking to get back in shape and be healthier than, at least before I was pregnant too. 9 months in, 9 months out is the way I looked at it.” (Group 4)

On the other hand, participants who experienced excessive weight gain in previous pregnancies or had past unsuccessful attempts to lose weight in prior pregnancies undermined their confidence in managing their weight during their current pregnancy. One participant expressed her feelings of frustration and a diminished confidence in effectively handling her weight during pregnancy.

“I gained 16 kilos. I don’t want to gain so much weight. I used to gain 25 kilos in my previous pregnancy, then it’s difficult to lose weight afterwards. Indeed, I did not return to a normal weight yet before having this baby. Thus, I put more and more weight on this baby. I think it’s about extra 10 kilos. It’s quite frustrating and shakes my confidence in being able to effectively handle my weight.” (Group 3)

Overall, the insights gained from the focus group discussions can inform the importance of providing comprehensive education and support regarding weight management to empower pregnant women, particularly among first-time mothers. Furthermore, the findings also underscore the positive implications of effective weight management during the current pregnancy for future pregnancies. By successfully managing their weight during pregnancy, women can potentially enhance their overall well-being and positively impact their subsequent pregnancies. This highlights the importance of addressing weight management as a crucial aspect of prenatal care to promote optimal health outcomes for both mothers and their future pregnancies.

4.3.4 Beliefs about consequences

According to the TDF’s definition, Cane et al. (2012, p.13) described beliefs about consequences as ‘acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation’ including beliefs, anticipated regret, and outcome expectancies.

Within this domain, the analysis of focus group discussions revealed beliefs of pregnant women about the role of prenatal vitamins and dietary supplements on the mother and the foetus’s health.

4.3.4.1 Belief in prenatal vitamins and dietary supplements

Many pregnant women believe that prenatal vitamins and dietary supplements additionally benefit the mother and the foetus’s diet during a pregnancy instead of diet alone. For example, a participant perceived taking vitamins and dietary supplements during pregnancy as a backup or a guarantee.

“I typically have three meals a day. However, I think it is also necessary for pregnant women to take vitamins and dietary supplements. You are carrying a baby, so you need to eat more foods, more nutrients and more energy. Although you can get all the essential nutrients that the body needs from foods, it’s not 100% sure. If you are not eating properly, your baby is not developing well. Right? These vitamins and supplements can offer additional benefits for individuals whose diet is incomplete of essential nutrients the body needs. For me, if you are not pregnant, you don’t need to take vitamins. However, if you’re pregnant, it’s essential to take vitamins because it’s for both you and the baby.” (Group 5)

All participants took iron and calcium supplements. However, some women did not perceive intake of these supplements as a preventive measure or treatment for nutrient deficiencies or nutrition-related issues. Instead, they viewed the supplements as a form of medicine to treat an illness. This perception was evident through the experiences shared by the participants.

“Notably, I often had cramps in my legs during pregnancy start. In addition, I felt dizzy when I changed my head or body position or moved from a seated position to a standing position, which usually lasts a few seconds or minutes. When I took this multivitamin, these symptoms seemed to be most relieved.” (Group 5)

Women initiated to use the iron and calcium supplements when they felt physical symptoms such as pains or cramps in their previous pregnancy and will continue to use them as a preventive purpose in their current pregnancy.

“I used the calcium supplement for my first pregnancy. You know! It’s useful, at least for joint pains I suffered in my previous pregnancy, so now I’m taking it for my current pregnancy. Goodness, it still works.” (Group 4)

Additionally, participants also mentioned folic acids in the focus group discussions. Vietnam’s Department of Health recommends individuals to consume a daily supplement containing 400 mcg of folic acid, irrespective of their dietary folate intake. This recommendation emphasizes the significance of folic acid supplementation during pregnancy to ensure adequate folate levels, as it plays a crucial role in foetal development and the prevention of certain birth defects. Some participants in the focus groups overlooked the supplementation of this vitamin for preventive purposes. They gave priority to foods rich in folic acid instead.

“I don't take folic acid from supplements because it's easier to absorb folic acids from foods like nut milk. I'm taking calcium and iron supplements.” (Group 5)

In addition, the adherence to micronutrient supplementation regimens involved finding a balance between perceived barriers and benefits. Pregnant women who recognized the positive effects of the supplements on their pregnancy, such as alleviating physical symptoms like pain, cramps, and supporting better sleep, as well as promoting the health of their foetus, placed a strong emphasis on the regular intake of these pills.

“I'm taking Elevit since pregnancy start. It [Elevit] contains calcium, iron, folic acid, and others. However, I found that this multivitamin does not add too much calcium, so I take an additional calcium supplement. The baby only gets all nutrients he needs from the mother, so I need a secure one. I bought two packs to last the entire pregnancy and 6-month postpartum [...] It's unsafe to supplement your new-born baby with vitamins pills. The newborn baby should be only fed with breast milk. The new-born baby will continue to get all nutrients he needs from you although he is born. Thus, I have to eat for my baby.” (Group 4)

The potential benefits to their postpartum health such as assistance with increased breast milk production also influenced some women's decision-making related to the adherence to these micronutrient supplementations.

“You should take calcium from the beginning of your pregnancy to breastfeeding. It also increases calcium in your milk as well [...] Many moms whom I knew do not produce enough milk for their baby because they did not take calcium in pregnancy. Moreover, the colour of their milk has a slight white appearance.” (Group 3)

Participants who did not observe any positive outcomes from taking the supplements or experienced side effects (e.g., having constipation, feeling “hot”), exhibited a laid-back attitude towards skipping their pill intake.

“My doctor also prescribed iron supplements [...] I also experienced stomach discomforts such as stomach upset, nausea, and constipation when taking iron pills. Now I've switched to a multivitamin. (Group 5)

Overall, the focus group discussions provided insights into the perceptions of pregnant women regarding the use of prenatal vitamins and dietary supplements. The perception among many pregnant women in the focus groups was that such supplements offered curative effects, such as pain relief and improved sleep, rather than acting as preventive

measures. The emphasis on curative effects over preventive measures suggests that pregnant women may prioritize immediate relief when considering the use of prenatal supplements. Thus, adherence to these supplements depended on perceived benefits. If these perceived benefits diminish, women may exhibit a more relaxed attitude towards supplement adherence.

4.3.5 Social Identity

According to the TDF's definition, Cane et al. (2012, p.13) described social identity as 'a coherent set of behaviours and displayed personal qualities of an individual in a social or work setting'. In this domain, the analysis of the focus group discussions found that women perceive themselves as good role models for their unborn babies' health and express a strong sense of responsibility to maintain a healthy diet at home.

4.3.5.1 Belief in “mommy transitions”

Participants have considered pregnancy as a moment for thinking of and making healthier changes that are essential for their foetal development, therefore it would appear that pregnancy is an ideal 'teachable moment' for positive behaviour change. For example, pregnancy could essentially affect women's lifestyle and nutrition behaviours later in their life. In this perspective, a pregnant woman in the focus group discussions has seen her pregnancy as an important turning point in her life that she was unaware of nutrition before.

“I have been skinny all my life. I never thought about it much but now I think it's affecting my baby. Getting pregnant, I'm sometimes extremely lethargic throughout the day. I think I don't get enough energy for both of us” (Group 5)

The analysis of the focus groups also revealed that participants, particularly first-time expectant mothers, made changes to their eating behaviour once they became pregnant. This included modifications such as avoiding low-nutrient foods and avoiding meal skipping. One participant shared how she made dietary changes to prioritize healthier food choices for herself and her baby.

“If you ask me there is any change in my diet since getting pregnant, I think I did not eat instant noodles anymore. I know that instant noodles do not have many nutrients. I must go to school by 7:00 every morning, so I do not have much time for kinds of stuffs such as cooking and taking my kid to school. Cooking instant noodles just fits my schedule in the mornings. Since getting pregnant, I felt nauseated once eating instant noodles, so I didn't want to eat anymore.” (Group 5)

In conclusion, the findings suggest that the participants recognized the significance of their pregnancy and its impact on the development of their unborn babies. This realization led to a heightened awareness of the need for proper nutrition and a shift towards healthier food choices. The participants actively adjusted their eating habits, avoiding low-nutrient foods and prioritizing nutrient-rich options. These changes were particularly evident among first-time expectant mothers. It highlights the potential of pregnancy as a ‘teachable moment’ for promoting positive behaviour change and emphasizes the importance of prenatal nutrition education and support to ensure the well-being of both the mother and the baby.

4.3.5.2 Women’s role and responsibility identity at home

The analysis of focus group discussions in Vietnamese pregnant women revealed that women had control over their diet. Food purchasing decisions differ among households, with greater consideration given to the needs of children, grandparents, and pregnant women (due to carrying an unborn baby) in extended family settings. The consensus among participants was that women take more responsibility for food purchasing. Additionally, cooking also seemed to be the main responsibility of women in the focus group discussions unless they were unable to cook due to morning sickness.

“I am the main chef of the family. Laughs” (Group 2)

Moreover, the insights gained from the focus group discussions revealed further intricacies encountered by certain women when preparing meals for their families, particularly in relation to diverse dietary preferences. This situation poses a challenge for pregnant women as they strive to accommodate multiple food choices while simultaneously meeting everyone's nutritional needs. An example shared by one participant highlighted the responsibility of cooking for seven people on a daily basis, which posed unique challenges.

I have to cook for seven people every day [...] My mother-in-law is a vegetarian while other family members including my husband, my older brother, my nieces, my son and me are non-vegetarians. Moreover, my 2-year-old son does not eat like us. Thus, I have to cook separate meals for my mother and my son. I’m in the kitchen all the time. (Group 3)

In brief, the focus group discussions with Vietnamese pregnant women revealed that women had control over food decisions and took responsibility for purchasing and cooking meals. They faced challenges in accommodating diverse dietary preferences within the family, requiring separate meal preparations. This added complexity to their role, particularly in extended family settings. The findings highlight the need for support and

resources to facilitate nutritious meal planning during pregnancy, considering the various nutritional needs of family members.

4.4 Summary

In conclusion, the COM-B model and TDF were used to map the healthy eating and weight gain behaviours among pregnant women in Vietnam. The analysis of focus group discussions revealed facilitators and barriers in three aspects: capabilities, opportunities, and motivations (see Figure 9). Pregnant women integrated both traditional and scientific knowledge to inform their healthy eating and gestational weight gain behaviour, although they had incomplete knowledge, particularly in specific food sources and consequences of inadequate weight gain. Women were motivated by their role as mother-to-be but were more likely to feel ashamed if they did not meet social and personal expectations. Micronutrient supplement adherence varied among women, with perceived curative benefits associated with adherence. Women also displayed proactive help-care behaviour and actively engaged in knowledge acquisition in relation to healthy eating and weight gain during pregnancy but faced challenges getting comprehensive information from healthcare professionals. Instead, women's active engagement with informal sources, such as social media and advice from family members, was perceived as beneficial due to their accessibility and convenience, allowing information gathering at their own pace and seeking reassurance from the experiences of others. Nevertheless, the relatability and trustworthiness of information from these informal sources, rooted in personal experiences and shared cultural beliefs, such as food beliefs and taboos, highlighted the significant influence of social and cultural factors on knowledge acquisition and decision-making. All these aspects will be further discussed in the next chapter.

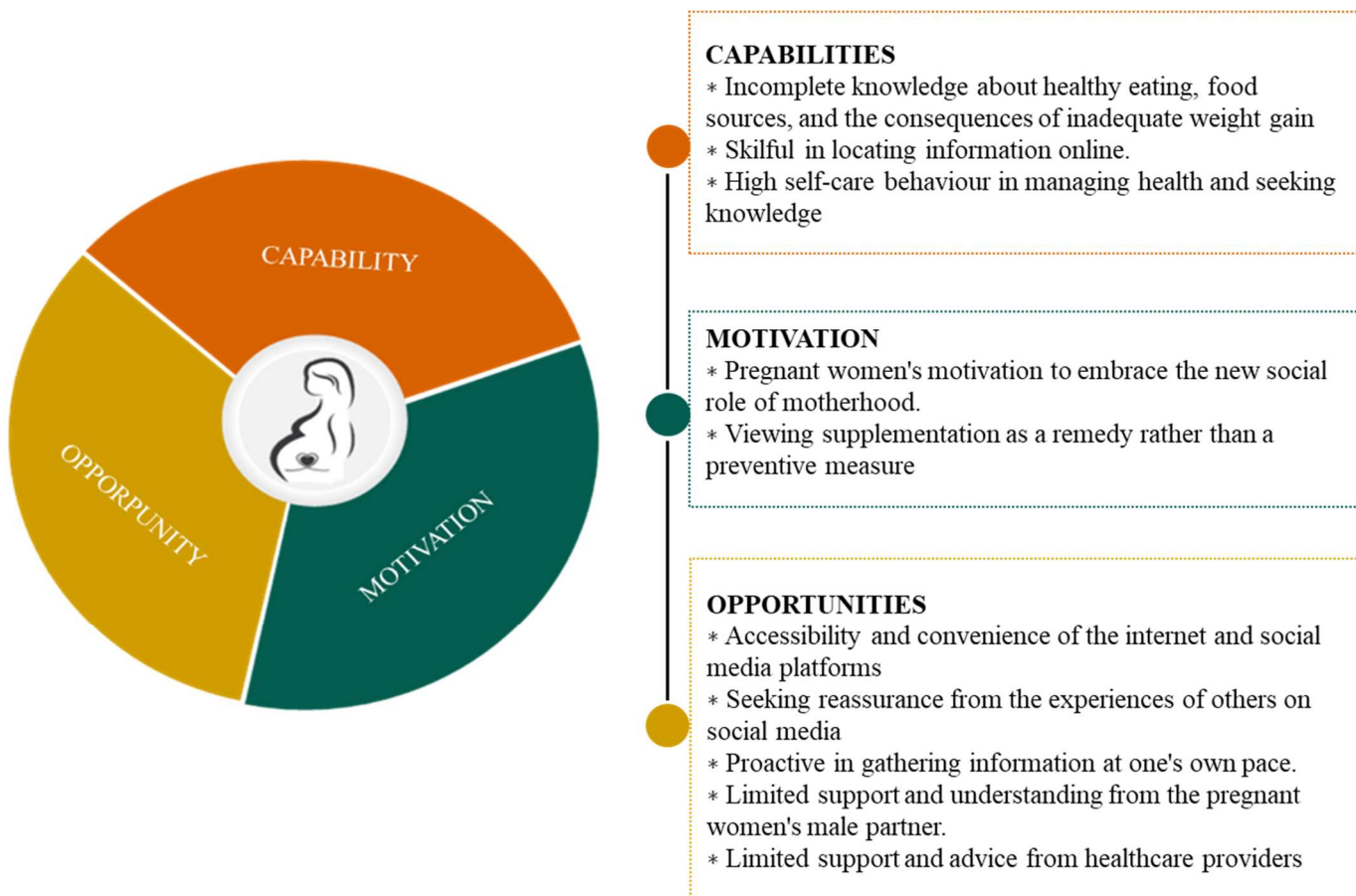


Figure 9: Facilitators and Barriers in Vietnamese pregnant women's capabilities, opportunities, and motivations

Chapter 5: Discussion on the findings from focus groups interviews

5.1 Using the TDF and COM-B model to inform the analysis.

This is the first study in Vietnam to use the COM-B model and the TDF to explore facilitators and barriers to healthy eating and weight gain among pregnant women in Vietnam. The findings have revealed all three aspects of the COM-B components to understand Vietnamese mothers-to-be's capability, opportunity, and motivation toward healthy eating and weight gain behaviours during pregnancy. Nine out of fourteen TDF domains including "knowledge, skills, environmental context and resources, social identity, emotion, intentions, beliefs about capabilities, social identity, and beliefs about consequences have been explored. The utilisation of the TDF, the COM-B model or both as a qualitative approach is catching the interest of the community of qualitative researchers due to its benefits for identifying influences on behaviours. Some studies in the Western populations (Murphy et al. 2014, Boyd et al. 2020) and fewer studies in Asia (Blebil et al. 2022) have used these frameworks to guide and map facilitators and barriers to various behaviours.

To my knowledge, two previous qualitative studies used the COM-B model alone (Grant et al. 2019), or a combination of the COM-B model and TDF (Flannery et al. 2018) to understanding the needs of the pregnant population. Flannery et al. (2018) conducted semi-structured interviews with thirty overweight or obese pregnant women in Ireland to explore the barriers and motivators to physical activity in this population. From the dataset, by using a framework analysis as a method for analysis, the authors identified 21 themes and mapped all into 10 out of 14 TDF domains and 3 components of the COM-B model (compatibility, opportunity, and motivation). Like Flannery et al.'s work, the present study also used the COM-B model in conjunction with the TDF domains to organize facilitators and barriers to healthy eating and gestational weight gain behaviour among pregnant women in Vietnam.

The present study identified 22 themes and subthemes by using Braun and Clarke's (2006)'s thematic analysis method. All the identified themes were shaped into 9 out of 14 TDF domains and three components of the COM-B model (see Table 7). Similarly, Grant et al. (2019) conducted in-depth individual interviews with 10 pregnant women in poverty in the UK, aiming to capture a detailed understanding of their perspectives, daily encounters, and social connections related to health behaviours during pregnancy. The collected data were subjected to deductive coding, focusing on alcohol consumption, smoking habits, and infant feeding practices. These coded data were subsequently analysed and organized with the three components of the COM-B model.

In conclusion, it has shown that the use of the COM-B models alone or a combination between the TDF domains and the COM-B models as a qualitative approach is feasible and effective to capture facilitators and barriers to health behaviours including healthy eating, physical activity, and weight gain in the pregnant population. By use of both the COM-B model and the TDF domains, the present study has additionally contributed to this work in the pregnant population in Vietnam.

5.2 Capability to healthy eating and weight gain during pregnancy

In terms of the TDF domain ‘knowledge’, few Vietnamese women in the present study specified the amount of weight they should gain or how to monitor weight gain, according to their prenatal BMI. They appeared to know that inadequate or excessive gestational weight gain (GWG) poses risks during pregnancy, yet many individuals struggle to identify the specific consequences associated with these risks. Similarly, it has been seen in women’s knowledge about food sources, particularly micronutrient-rich foods, and carbohydrate sources. Women had not only low knowledge of food sources but also did not specific consequences of the risk of micronutrient deficiencies. According to Janz and Becker (1984)’s Health Belief Model, people are motivated to engage in preventive health behaviours when they place a high value on their health and recognize their susceptibility to health risks. Knowing the risks associated with inadequate or excessive GWG and adequate micronutrient intake, along with valuing healthy GWG and nutritious eating as means of mitigating these risks, may enhance women's propensity to acquire and retain knowledge about GWG and dietary recommendations during pregnancy. The finding of the present study is essential because it has provided evidence for researchers, policymakers and educators on the development of an educational program for pregnant women in Vietnam. Women should be educated about knowledge about GWG and healthy eating as well as the risks of the nutrient deficiency. Having knowledge empowers individuals to make wiser decisions and take actions that align with their desired outcomes. Spronk et al. (2014) highlighted the influence of knowledge on dietary intake and the multifaceted aspects of consumer behaviour related to food, such as attitudes, perceptions, and decision-making processes. Wardle et al. (2016) further found that individuals who possess a higher level of knowledge regarding nutritional recommendations exhibit a stronger adherence to these guidelines, especially when it comes to food items such as fruits, vegetables, and fat.

In terms of the ‘skills’ linked to pregnant women’s capabilities, the participants in the present study showed the high level of self-care and independence reflects the participants' capability to make informed choices for themselves and their babies, highlighting their active

engagement in managing their health during pregnancy. The findings of the present study regarding the self-care practices among pregnant women demonstrated a resemblance to the results reported by Puspita et al. (2015) in their study on Indonesian pregnant women. Self-care, an umbrella term defined by the World Health Organization (WHO) in 1983 and further expounded upon in its latest report in 2022 (WHO 2022, p.8), refers to “the ability of individuals, families and communities to promote health, prevent disease, maintain health, and to cope with illness and disability with or without the support of a health-care provider.” Martínez et al. (2021) describe self-care from an individual perspective as the ability to consciously address one's own needs, practicing self-discipline, and relying on oneself to achieve, maintain, or enhance optimal health and well-being. Earlier study indicated that pregnant women engage in self-care through a range of behaviours, such as seeking health information, making dietary adjustments, participating in physical activities, prioritizing rest, and practicing meditation (Patterson et al. 1990; Hawkins et al. 1998). Consistent with these studies, the pregnant women included in the current study demonstrated a noteworthy degree of self-care and autonomy in managing their health and acquiring information. Hawkins et al. (1998) highlighted the role of social supports, including healthcare providers and family members, in influencing the self-care behaviours of pregnant women. In another study conducted by Boonyaprapa et al. (2010), which involved in-depth interviews with 43 Thai women who were either pregnant or breastfeeding, it was found that self-care behaviours among Thai women were influenced by the absence of support and guidance from their healthcare providers. The results of the present study align with Boonyaprapa et al. (2010) ‘s the findings, as pregnant women reported feeling unsupported by healthcare providers, as mentioned in the "Opportunity" component discussed in Section 5.3. The significance of health professionals in the self-care behaviours of pregnant women in Vietnam has also been highlighted in a recent cross-sectional study conducted by Nguyen et al. (2022). Through a survey involving approximately 600 pregnant women, Nguyen et al. (2022) revealed that information sources and social support played key roles in driving self-care practices. Notably, their findings highlighted the crucial role played by online information sources, such as websites and social media platforms, in supporting and promoting self-care practices. However, it is imperative for healthcare professionals to ensure the accuracy and reliability of these information sources. It is worth noting that self-care is recognized as a vital element of person-centred health interventions, which emphasize individuals' involvement in identifying their health goals, making informed decisions, and collaborating with healthcare providers to develop personalized care plans (Narasimhan et

al. 2019). WHO (2019) has recently advocated for the integration of self-care interventions in prenatal care, including the management of pregnancy-related complications.

In addition, Vietnamese pregnant women's confidence in using search engines like Google and their ability to locate information from various online sources, including websites and social media, are considered valuable skills. The internet has become popular for accessing health-related information during pregnancy, regardless of geographic location or economic development (Eysenbach et al. 2002; Lagan et al. 2010; Gao et al. 2013)). In Vietnam, pregnant women have easy access to online information sources due to widespread internet availability, as highlighted in the "Opportunity" component discussed in Section 5.3. Research has demonstrated that many pregnant women rely on the internet as a source of information to address uncertainties and navigate decisions related to pregnancy (Song et al. 2012). According to a systematic review conducted by Sayakhot and Carolan-Olah (2016), the capability to navigate and utilize online sources empowers pregnant women to conveniently access a wealth of information at their own pace. However, it is important to note that pregnant women often did not discuss the information obtained online with their healthcare providers despite their confidence in using online resources (Sayakhot and Carolan-Olah 2016). The lack of communication with health professionals or time constraints during visits can account for this phenomenon. My present study revealed that insufficient communication with health professionals or time constraints during visits serve as barriers to the exchange of information between healthcare providers and pregnant women (see Section 5.3). Future efforts should focus on bridging this communication gap to ensure a comprehensive approach to prenatal care.

5.3 Opportunity to healthy eating and weight gain during pregnancy

In terms of the 'Environmental context and resources' domain linked to women's opportunities, pregnant women in the present study desired to seek information about diet during pregnancy although unbiased or trusted online sources of information about healthy eating during pregnancy were lacking. Deave et al. (2008) emphasised the significance of access to reliable information for women's well-being and overall experience during pregnancy and childbirth. Previous studies have shown that pregnant women actively seek information to enhance their confidence and comfort in communicating with healthcare providers, making informed decisions during the perinatal period, and preparing for motherhood (Kamali et al. 2018). Bjelke et al. (2016) added that it could increase women's worries and anxiety during pregnancy, leads to isolation and predicts low confidence as parents when women are not provided the information they need.

In terms of information sources, the pregnant women who participated in the present study demonstrated a proactive attitude towards seeking information related to their health, indicating their eagerness to make informed decisions. This proactive behaviour suggests that they are open to receiving nutritional advice or education as they have already demonstrated a willingness to seek out such information on their own. They found online information sources available and accessible. This can be explained by the advance and accessibility to the Internet in Vietnam. According to the report of AlphaBeta (2021), 74% of people in Vietnam can access the internet, and the ownership of smartphone is 93% of all users aged 16 to 64. People getting news online daily in Vietnam are comparable to those in developed countries (Pew Research Centre 2018). According to the Pew Research Centre (2018)'s report, the age group of 18 to 29, regardless of gender and income, comprises the largest segment of the population that accesses daily information online. Notably, this age group constitutes 84% of daily online news consumers in Vietnam (Pew Research Centre, 2018).

In terms of the 'social support' linked to women's opportunities, Vietnamese women in the present study had little advice and support about diet and weight gain from their healthcare providers. Even they requested, they benefited very little from their doctor's answers on diet-related issues; the advice was often inadequate and generic. Pregnant women even felt embarrassed or dissatisfied because their healthcare providers often overlooked or withheld their nutrition-related questions. This discovery highlights the necessity for enhanced communication between pregnant women and healthcare professionals, specifically concerning diet-related matters. Although the healthcare system and reproductive health services in Vietnam have significantly improved, with a high rate of antenatal visits and care from skilled health professionals (see Section 2.6.2), there is still room for improvement in communication. Kavle and Landry (2018) highlighted in their systematic review of studies conducted in low-middle income countries that few healthcare providers offered pregnant women guidance on diet and gestational weight gain during clinical visits. Unless specifically requested, women might not receive nutritional advice during pregnancy (Knight-Agarwal 2020, Stockton 2020). The analysis of data collected from various qualitative and quantitative studies revealed that time limitations during prenatal visits and healthcare providers' limited knowledge about recommended weight and nutrition guidelines could be contributing factors (Lucas et al. 2014). Nevertheless, it is important to highlight that enhancing communication with women regarding gestational weight gain and diet has the potential to foster positive changes in their eating behaviour and address cultural beliefs

or misconceptions regarding food preferences during pregnancy (Kavle and Landry, 2018). The effect of the absence of communication with healthcare professionals can be observed in the low adherence to recommended healthy dietary intakes for pregnancy (Caut 2020).

The absence of effective communication and a limited understanding of their needs during pregnancy by their male partners also contributed to a sense of inadequate support among the pregnant women in this study. Research indicates the significance of expectant fathers in promoting the health of both the mother and the unborn baby. The findings of the present study regarding dissatisfaction with support from their partners among pregnant women demonstrated a resemblance to the results reported by Phoosuwan et al. (2020) in their study on Thai women. Notably, the involvement of fathers-to-be in antenatal care services can provide support to expectant mothers in terms of pregnancy health and nutrition, reduce domestic violence, prepare for childbirth, prevent pregnancy-related complications, and foster an early bond with the unborn baby (Yargawa and Leonardi-Bee 2015; Lee et al. 2018). The World Health Organization (2015) strongly recommends the active engagement of expectant fathers in antenatal interventions, including nutrition education. However, the crucial role of fathers often remains unrecognized by pregnant women, primarily due to the lack of education and support that encourages the fathering role during pregnancy. This finding has been consistently reported in previous studies (Burck 1995, Kraemer 2000, Featherstone 2010). While male involvement in prenatal care holds promise for improving the health and well-being of mothers and unborn babies, it is crucial to recognize the challenges faced by men in actively participating. A recent systematic review and meta-analysis by Roudsari et al. (2023), focusing on studies conducted in developing countries, highlighted that the current state of prenatal health services does not adequately support men's engagement. To foster active participation, it is essential to establish supportive environments that enable fathers to contribute to antenatal care, and policies and interventions in prenatal health should explicitly include men as key stakeholders.

In addition, it emphasised that the importance of connection with other women's experience to seek reassurance from the experiences of others as well as seeking information to make their own decision-making. Notably, the findings of the present study also highlighted the increasing influence of social media in shaping the information-seeking behaviours of pregnant women in Vietnam and their growing reliance on online sources for health-related information. Most of the women in the present study revealed that Facebook is a useful platform for them to exchange knowledge as well as to find support through their stressful pregnancy life. Findings from a survey conducted by The Asian Parent (2021) among 500

Vietnamese mothers, including both pregnant (42%) and non-pregnant (58%) individuals, supported the notion that nearly 98% of them actively use Facebook. With approximately 58 million users, Facebook stands out as the most popular social network in Vietnam. Among its users, over 60% fall within the age range of 18 to 44 (Statista, 2020). In a survey conducted by the Pew Research Center (2019), which included 2,500 adults from various regions of Vietnam, it was found that 63% of the respondents are active Facebook users. The survey revealed that Facebook usage is particularly prominent among two age groups: 18-29-year-olds, with 91% reporting frequent usage, and 30-49-year-olds, with 62% engaging with the platform regularly. Furthermore, the survey revealed that there is a similar frequency of Facebook usage between female users (62%) and male users (64%). This makes Facebook an ideal platform for women in their childbearing years. A study conducted by YouNet Media (2017) disclosed that 90% of Vietnamese mothers considered Facebook as the primary platform for sharing knowledge related to pregnancy, and birthing experiences. The respondents in the YouNet Media study were primarily from two biggest cities in Vietnam, Ho Chi Minh City and Hanoi. This is comparable to research participants in this present study who are almost living in Ho Chi Minh and Hanoi city (see Table 6).

While wanting accurate information, Vietnamese women in the present study were aware that information obtained online could be inaccurate or biased. Their main concern is whether the information is trustworthy. To assess the reliability of the information Women gathered information on one topic from a variety of sources; it was presumed to be trustworthy if similar information can be found in different sources. Boon-itt (2019) demonstrated that the trustworthiness and usefulness of information may impact women's use and appreciation of information.

The findings of the present study first revealed food cultures and taboos among pregnant women in Vietnam. A previous study by Lundberg and Trieu (2011) also demonstrated that the 'Am and Duong' harmony influenced women's health behaviours including nutrition during breastfeeding. To date, this present study has revealed that the 'Am and Duong' harmony on the balance between 'cold and hot' foods (see Section 4.2.2.4) still prevails during pregnancy. Furthermore, the present study uncovered the presence of common food taboos and beliefs among Vietnamese pregnant women. For instance, coke is often avoided as it is believed to potentially affect the baby's skin appearance negatively. On the other hand, consuming animal organs, such as pig brain, is encouraged as it is believed to contribute to the baby's intelligence or overall health. Additionally, the current study revealed that Vietnamese women favour the intake of sugar cane juice or coconut milk

during pregnancy. This preference stems from the belief that these beverages may have a positive impact on the baby's skin appearance. Coconut milk and sugar cane juice are common food taboos with different meanings in Southeast Asian countries. For example, Indonesian women believe sugar cane is associated with making babies' ears watery (Triratnawati et al. 2016). According to previous studies, both Lao and Cambodian women believed that consuming coconut milk during pregnancy could potentially lead to increased weight in their unborn babies and potentially cause difficulties during delivery (Holmes et al. 2007; Montesanti, 2011; de Sa et al. 2013). This highlights the need to provide dietary advice that takes into account food beliefs and taboos among pregnant women. It is important to approach this advice in a professional and non-judgmental manner, as the meaning of food taboos may vary and depend on individual perceptions. By working with existing beliefs, as long as they are not harmful, it can provide more effective advice and support for pregnant women to promote a healthy diet during pregnancy.

5.4 Motivations for healthy eating and weight gain during pregnancy

The present study demonstrated that Vietnamese women have increased motivation to improve their eating behaviours during pregnancy. This has often been seen among the pregnant population in previous studies (Lindqvist et al. 2017; O'Brien et al. 2017). This present study also demonstrated that women were also encouraged to adopt the new social role of a mother once they became pregnant. They indicated that their perceptions of the importance of a healthy diet for themselves and their foetuses contribute to their perceptions of being a 'good mother' when eating healthy food. However, feelings of guilt and distress over a lack of self-control may grow as they consume unhealthy foods and perceive themselves to be a 'bad mother'; this is linked to the domain 'Emotions'. Many women in the present study blamed themselves for doing something 'wrong' when they were out of control of food cravings.

It is possible that individuals are aware of the notion that "eating healthier promotes positive health" (Holli and Beto 2017, p.124), but they may provide reasons to resist changing their current state, including the consumption of unhealthy foods. People often experience ambivalence regarding whether to change, such as saying, "I want to eat healthier for my baby, but I enjoy my current eating habits." Once they overcome the conflicting thoughts that hinder change, they can make a decision and take action for a change (Holli and Beto 2017). The period of pregnancy can be considered an opportune time for healthcare providers to discuss healthy weight gain among women, as they value and desire positive changes in their eating behaviours for better outcomes for their offspring. Studies conducted

in both developing and developed countries has shown that enhancing communication between pregnant women and healthcare providers is associated with various positive outcomes. These include the exchange of crucial information, the establishment of a positive interpersonal relationship, and a reduction in pregnancy-related anxiety (Rowee et al. 2002; Nicoloro-SantaBarbara et al. 2017; Kazi et al. 2021). Notably, in the present study, women received little advice and support from their healthcare professionals (see Section 5.3).

In addition, several biopsychosocial changes may occur in a short period time during pregnancy period (Skouteris et al. 2012). For example, the woman may experience symptoms of morning sickness such as nausea and vomiting, affecting up to 80% of all pregnant women, as globally reported (Lee 2011). Additionally, the changes that occur in women's weight during pregnancy can have consequences on their body image (Duncombe 2008; Meireles 2017). Relating to the domain 'Beliefs about capabilities', women in the present study had low confidence in the management of pregnancy-related changes, such as weight gain or the symptoms of morning sickness. Taking morning sickness symptoms as an example, they expected that these symptoms go away after the three first months of pregnancy. However, it could cause further feelings of worthlessness if these symptoms continue to exist a bit longer than their expected time. Similarly, some women in the present study, particularly women with excessive weight gain during pregnancy, found the management of weight gain challenges. The reason for this could be their negative previous experiences with excessive gestational weight gain or lack of knowledge about weight gain during pregnancy (see Section 4.3.3.2). Low confidence in the management of changes during pregnancy should be negative consequences for seeking assistance and decision making as well as health behaviour, including nutrition (Pereira 2008).

The finding of this present study has also found that Vietnamese women engaged in taking micronutrient supplements during pregnancy, but adherence varied. Women's perceptions of the curative benefits of taking prenatal micronutrient supplements (e.g., pain and cramp relief, sleep support) have been recognized as associated with adherence. Women tended to be more relaxed about skipping these supplements if the benefits disappeared. The finding of the current study aligns with a previous study conducted in Vietnam by Nechitilo et al. (2016). The study involved interviews with 39 participants of the PRECONCEPT trial, which focused on prenatal micronutrient supplements. The participants included 15 nonpregnant women, 8 pregnant women, 8 postpartum women, and 8 women who discontinued their participation in the trial. It also emphasised that adherence to prenatal supplement intake was affected by women's misconception of the health benefits of taking

these supplements. Reasons for this could be a lack of knowledge about micronutrients and relevant deficiencies among women. This has been identified in the present study (see Section 4.1.1.1). Besides, the present study also found that side effects (e.g., constipation, acne), particularly about iron supplements, have also been reported as barriers to adherence. In this present study, women who had an unplanned pregnancy were more likely to miss taking folic acid supplements. Another common reason for not taking folic acid is that women did not feel necessary to take folic acid from supplements. Previous studies demonstrated that unplanning pregnancy and not feeling necessary to take from supplements are the most common barriers to folic acid supplement intake before and during pregnancy (Bixenstine et al. 2015; Ezzeddin et al. 2019; Ikeda-Sakai et al. 2019).

Chapter 6: Developing a logic model.

Early consideration of evaluation design need to be made when developing interventions. A logic model is considered beneficial to present systematically and visually the causal pathways between proposed intervention components and expected outcomes, as well as identifying the planned mechanisms by which these intervention components will generate the desired behaviour change (Knowlton and Phillips 2013).

The Scottish Government's (2016) 5-step approach for design and evaluation of behaviour change interventions has been employed to develop a logic model for my intervention program. The 5-step approach consists of identifying a problem, reviewing systematically relevant evidence promoting the intervention, creating a logic model to illustrate all theories of change of the intervention, monitoring the logic model, and evaluating the logic model.

6.1 Identifying a problem.

To create an impactful intervention, it is essential to identify the key behaviours that require modification and understand why addressing them is a top priority. This involves asking a series of important questions, such as "What is the problem?", "Why is this problem significant?", and "What is the ultimate goal?" These inquiries should be taken into account when evaluating and addressing the issue at hand.

What is the problem?

As discussed earlier in Chapter 2, studies conducted in Vietnam has highlighted the prevalence of inadequate gestational weight gain and undernutrition among pregnant women, with a particular focus on micronutrient deficiencies such as iron, calcium, folate, and vitamin A (Tu et al. 2014; Nguyen et al. 2018; Tran et al. 2019).

Why is this a problem?

Evidence indicated that inadequate micronutrient intake in mothers could elevate the risk of abnormal development and non-communicable chronic diseases in unborn babies (Hanley et al. 2010; Procter et al. 2014). Meta-analyses conducted in lower-middle-income countries, including Vietnam, revealed that low nutrition status and insufficient gestational weight gain were associated with a 30% increase in premature birth and up to a 70% risk of delivering a baby with low birth weight or small for gestational age (Rahman et al. 2015; Liu et al. 2016).

What is your ultimate aim?

I aim to help pregnant women in Vietnam have adequate nutrition status and healthy weight management during pregnancy.

6.2 Reviewing systematically relevant evidence promoting the intervention.

This intervention program aims to improve nutrition status, particularly micronutrient intake, and healthy weight management of Vietnamese women during their pregnancy. The relevant evidence supporting the intervention has been reviewed and compiled in Table 8.

Table 8: Evidence of why the intended intervention program may work

Intervention Program	Evidence
This intervention program aims to help women in Vietnam have adequate nutrition status and healthy weight management during pregnancy.	As discussed early in Section 6.1 and extensively explored in Chapter 2, there is compelling evidence highlighting the significant prevalence of inadequate gestational weight gain and undernutrition among pregnant women in Vietnam. These findings underscore the urgent need for targeted dietary behaviour interventions for this specific population.
The intervention program is targeted at pregnant women aged 18-29 in Vietnam.	Vietnam's National Statistics Office shows that the age group between 20 and 29 is the most common reproductive age in Vietnam with an age-specific fertility rate of 120-130 per 1000 women (Vietnamese Central Population and Housing Census Steering Committee 2019). These ages have been consistently reported as an association with malnutrition during pregnancy in studies in Vietnam.
The intervention program will use a smartphone application with three purposes: ▪ To deliver education about healthy eating and healthy weight gain. ▪ To promote adherence to dietary supplements during pregnancy. ▪ To raise the awareness of male partners regarding their role in supporting pregnant women. ▪ To foster communications between pregnant women and healthcare	There is evidence supporting the feasibility of implementing a smartphone application-based intervention program for pregnant women in Vietnam. a. Evidence on the mobile-based Health (m-Health) for prenatal health Mobile health (m-health) refers to the use of mobile devices, such as smartphones and tablets, to provide healthcare services and information to individuals. With the widespread availability of mobile technology, there has been an increase in the development of m-health applications, ranging from those that aid in the management of chronic conditions to those that promote healthy behaviours and provide remote access to healthcare providers. In the field of prenatal care, mobile technology has the potential to provide a personalized healthcare service, which is private and can be delivered through wearables (Heron

professionals (e.g., dietitians or nutritionists).

et al. 2010; Fieldsoe et al. 2009). A recent report by Pew Research Centre on 27 countries including Vietnam showed that the highest proportion of smartphone owners being those under 35 years in both developed countries and developing countries (Silver et al. 2019). Critically, this age group in the reproductive ages. The growing prevalence of smartphone health applications among expectant parents in search of information on maintaining a healthy pregnancy is also apparent (Rodger et al. 2013; Sayakhot et al. 2016). Expectant parents can take advantage of the mobile phone-based prenatal care model, which enables them to receive comprehensive health education, engage in self-care practices, and seek remote consultation services at their convenience, unrestricted by time or location (Feroz et al. 2017). The use of mobile technology in maternal care is believed to contribute to the achievement of the Millennium Development Goals, particularly in improving maternal care, as suggested by the United Nations. The World Health Organization (2019) has identified digital technology as a strategic priority for improving healthcare due to its cost-effectiveness and efficiency. Additionally, the promising results of the randomized controlled trial by Ledford et al. (2015) demonstrate the potential of mobile technology to increase engagement in learning compared to traditional methods. In conclusion, mobile health technology has become increasingly popular, particularly among younger generations, and has the potential to provide personalized prenatal care, education, and teleconsultation services. The use of mobile technology in maternal care is a cost-effective and efficient means of improving healthcare, contributing to the achievement of the Millennium Development Goals and supporting the strategic priorities of the World Health Organization.

b. Evidence on smartphone availability in Vietnam

Nearly 74% of people in Vietnam can access the internet, and 93% of all users aged 16 to 64 own a smartphone (AlphaBeta 2021). 6. According to the Pew Research Centre study (2018), advanced countries typically rely more on online news sources on a daily basis compared to developing countries, with Vietnam being an exception. Vietnam stands out among developing countries, where the age group between 18 and 29, irrespective of gender and income, represents the largest group of people accessing daily online information. This age group accounts for 84%

	of daily online news consumers in Vietnam (Pew Research Centre, 2018). c. Evidence on using mHealth applications in Vietnam. A systematic review by Nguyen et al (2022) demonstrated that the practicality, usefulness, and feasibility of some mHealth applications have been evident in various fields such as maternal and infant health, HIV, and sexual and reproductive health. Moreover, studies emphasized that individuals aged between 15 and 24 in Vietnam expressed satisfaction with mHealth innovations and showed readiness to embrace more useful mHealth applications (Tran et al. 2018, AlphaBeta 2021). d. Evidence on smartphone application-based interventions for healthy eating and weight management during pregnancy Smartphone apps are frequently used by pregnant women as a source of health information (Lupton & Pedersen, 2016; Wang et al. 2019). Meta-analyses of international literature on mHealth interventions for maternal nutrition have been found to improve diet and weight management during pregnancy (Overdijkink et al. 2018; Brown et al. 2019). Moreover, the mobile technology-based approach to prenatal care is considered flexible and accessible for pregnant women to communicate with their HCPs (Kashgary et al. 2017; Krishnamurti et. al. 2021)
Facebook will be used as the main channel for participant recruitment to join the interventional program.	Facebook, the most widely used social media platform in Vietnam, can offer advancements in recruitment (Thornton et al. 2016), exploratory research (Kallem et al. 2018) and intervention (Fiks et al. 2017) for this population in previous studies. A report by YouNet Media (2017) revealed that 90% of mothers in Vietnam found Facebook the most popular platform to exchange knowledge about pregnancy, birthing experience, and maternity hospitals. The Pew Research Centre (2018) also emphasised that the ages between 18 and 29, regardless of gender and income, are the biggest group of people getting information daily via social media in Vietnam. The age group between 20 and 29 is the most common reproductive age in Vietnam with an age-specific fertility rate of

	120-130 per 1000 women (Vietnamese Central Population and Housing Census Steering Committee 2019).
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6.3 Developing a logic model for a mHealth intervention.

The aim is to maintain adequate nutrition status and healthy weight gain among pregnant women in Vietnam. As revealed in Chapter 4 and further discussed in Chapter 5, my qualitative study uncovered a range of barriers and facilitators that affect the capability, motivation, and opportunity of Vietnamese pregnant women when it comes to promoting healthy eating and maintaining a healthy weight during pregnancy. The following are the identified barriers and facilitators.

Identified barriers:

- **Capability:** Pregnant women had limited knowledge of gestation weight gain and a healthy diet, particularly micronutrient-rich food sources and carbohydrate sources. Moreover, they did not know about eating a variety of foods during pregnancy to get essential micronutrients such as vitamins and minerals.
- **Opportunities:** Pregnant women are lacking unbiased or trusted online sources of information about healthy eating during pregnancy. Additionally, women had little support and encouragement from healthcare professionals, as well as little communication and understanding from their male partners to maintain good nutrition during their pregnancy.
- **Motivations:** An obstacle observed is the misalignment of motivations regarding dietary supplementation, such as folic acids, calcium, and iron, during pregnancy. These supplements are often perceived as curative treatments rather than preventive measures, affecting the motivation to incorporate them into the pregnancy nutrition regimen.

Identified facilitators.

- **Capability:** Pregnant women demonstrated a notable level of self-care and proactivity in managing their health and seeking information. The confidence displayed by Vietnamese pregnant women in using search engines and accessing information from various online sources highlights their additional skills in this domain.
- **Opportunity:** Pregnant women highlighted the significance of connecting with other women's experiences to find reassurance and gather information for their own decision-making process.
- **Motivation:** Pregnant women expressed motivation to embrace the new social role of motherhood upon becoming pregnant. They emphasized the significance of

maintaining a healthy diet for their own well-being and the well-being of their unborn babies.

As seen in Figure 10, a logic model has been developed for a smartphone application-based intervention program. The program contains the intervention functions of education, persuasion, enablement, self-motoring, and prompt contact to healthcare professionals (HCPs) to enhance key aspects of capability, motivation and opportunity identified in the behavioural analysis. The intervention would help pregnant women develop the knowledge and skills for maintaining adequate nutrition status and healthy weight gain, as well as enhance how pregnant women are supported by healthcare professionals to retain their capacity, capability, and opportunity for the key barriers they undergo. Hence, a variety of intervention innovative features will be developed to enhance their knowledge capability about healthy eating and weight management during pregnancy, but ensure it is user-friendly, personalised, and flexible. The package encompasses friendly pre-recorded videos and text displays featuring vital information that is beneficial for their knowledge. Additionally, it provides sources of information for addressing common questions or issues they may encounter, along with a built-in forum where they can pose queries to healthcare professionals. This forum seamlessly integrates into the smartphone application. The program participants can integrate their social media account (e.g., Facebook account) into the program to regularly receive notices, education materials, and join participant networks. Videos, infographics, or recipe displays will be included to emphasize the importance of male partners or fathers taking an active role in promoting baby health. These resources will consistently portray the involvement of both mothers and fathers, highlighting the significance of their contribution during pregnancy, whenever appropriate. Social media platforms will be leveraged to foster engagement and facilitate the promotion of activities, as well as to encourage participants to connect and build networks. The rationales for the component development of the program's logic model will be discussed later.

Based on the insights gained from my supervisors' discussions and the findings of the focus group interviews with pregnant women in my qualitative study of the present thesis (see Chapter 4), I will identify several desired outcomes that stakeholders, such as pregnant women, expect to be achieved through the activities of my intervention program.

- An intervention program to provide information and practical advice on healthy gestational weight gain and healthy eating, which will be tailored to the gestational week, demographic, and characteristics (e.g., pre-natal BMI) of the

participants. It also includes tips for cooking and simple recipes that pregnant women can follow to increase the variety of micronutrient-rich foods.

- A cue or prompt to persuade and remind pregnant women of taking dietary supplements as prescribed.
- Motivational videos or other materials that educate the role of healthy eating in the foetus' health as well as increase communications between pregnant women and their male partner in home environment.
- An opportunity for pregnant women to be confident in problem-solving by either self-monitoring to seek answers to common questions or asking HCPs for tailored answers to their questions.

If the outcomes above are successfully attained, the program is expected to generate short-term effects for pregnant women, at least throughout the duration of their pregnancy. It is expected that pregnant women would increase their knowledge about foods and know how to get variety in their meals. Additionally, they also know the importance of weight gain during pregnancy and how to increase healthy weight gain throughout their pregnancy. Pregnant women also increase communications with their male partners. They should be able to describe their needs with the male partners and persuade the male partners in prenatal nutrition practices at home or in classes. A systematic review and meta-analysis of lower-middle-income countries revealed that husbands who accompanied their partners to antenatal care demonstrated significantly higher levels of knowledge compared to those who did not (Suandi et al. 2019). This increase in knowledge is closely linked to positive outcomes for maternal and child health, such as greater utilization of antenatal care services and improved awareness of danger signs (Suandi et al. 2019). Lastly, they should feel competent in problem-solving skills.

In the medium-term, it anticipates that these advantages for mothers will have direct effects not only on themselves, such as a decrease in malnutrition and associated complications during pregnancy, but also on their babies, such as the birth of a healthy child. Over the long term, including the lactation period and subsequent pregnancies, these changes are expected to encourage pregnant women to maintain healthy eating habits, manage their weight, and recognize the involvement of their male partners in the baby's health and nutrition-related activities. The ultimate goal is for pregnant women to develop confidence in adopting a healthy diet and effectively managing their weight, while also influencing other women within their social network, such as friends and relatives, to do the same.

6.3.1 Intervention program resources and influential factors

An analysis of environmental factors was conducted to assess the availability of resources for the intervention program. This evaluation aimed to determine the existing support and infrastructure that can contribute to the successful implementation of the program. The followings are potential resources for the intervention program in Vietnam.

Staffing requirements and technological support

The successful implementation of this intervention will require various types of staff, including research and HCP staff, as well as tech development staff. To ensure the success of the program, it is essential to assemble a diverse research team with expertise in various fields including maternal health, nutrition, health psychology, program development, and evaluation. Although I have previous experience as a registered nutrition practitioner in maternity hospitals and as a member of an advisory board and educator for nutrition programs targeting children and mothers in Vietnam, the program's effectiveness will be greatly enhanced by the contributions of a multidisciplinary team.

To ensure the successful implementation of the intervention program, it will be necessary to involve healthcare professional (HCP) staff from various sources, including medical schools, the Institute of Nutrition, and both public and private hospitals. Additionally, the program will require the collaboration of tech development staff. Healthcare-support tech companies such as Viettel Group and tech development and research teams from universities like RMIT University Vietnam's high-tech hub can work together to develop a dedicated smartphone application for the intervention program.

Authority approval and funding source

The successful implementation of this intervention program in Vietnam will require obtaining permission from the relevant authority. In Vietnam, the Maternal and Child Health Department of the Ministry of Health is responsible for overseeing all health programs. Additionally, funding sources will be needed to support the implementation of the program. Fortunately, there are non-profit organizations in Vietnam that are willing to provide funding support for research on motherhood and child nutrition, such as UNICEF Vietnam, Samaritan's Purse Vietnam, and the Child Nutrition Foundation.

Supportive nutrition strategy and policy for maternal health in Vietnam

In Chapter 2, I conducted a comprehensive literature review of Vietnam's existing policies and guidelines concerning maternal health and nutrition during pregnancy. It revealed that

the current nutrition strategy and policy in Vietnam actively promote and support maternal nutrition (see Table 4). In summary, Vietnam's latest national nutrition strategy from 2021 to 2030, and towards 2045 has set optimal nutrition during pregnancy, particularly adequate micronutrient intake, as one of four key goals (Prime Minister 2022). Moreover, according to the World Health Organization (WHO), nutrition education is one of the 26 essential components of routine antenatal care recommended. The recommendations have already been aligned with Vietnam's national guidelines for reproductive healthcare (WHO 2018). As a result, Vietnam's Ministry of Health (MOH) has published a variety of educational materials about maternal health and nutrition, including videos and infographics that have been widely implemented in local health departments and hospitals. The MOH of Vietnam publishes the national guidelines on nutrition for pregnant women and breastfeeding mothers (Vietnam Ministry of Health 2017). This guideline provides guidance on healthy eating patterns, the significance of key nutrients during pregnancy, as well as dietary and vitamin supplementation, adherence to food safety measures, avoidance of certain foods, and management of weight gain during pregnancy (see Table 3). Moreover, the Vietnamese food-based dietary guidelines (FBDGs) have been established, implemented, and validated for diverse population groups, including pregnant women (National Institute of Nutrition 2016). The FBDGs for pregnant women can be seen in Appendix 2. To assess dietary quality in accordance with the Vietnamese FBDGs, the Vietnamese Healthy Eating Index has been recently devised (Van et al. 2022). This index not only serves as a measure of adherence to the guidelines but can also function as a monitoring tool for nutrition interventions aimed at enhancing dietary quality. Therefore, these resources serve as valuable reservoirs of educational materials and assessment tools related to dietary quality for the intervention program. They facilitate the development of intervention components tailored to the needs of pregnant women, promoting their active engagement and participation.

Influence of family environment on maternal nutrition

The family environment of pregnant women, in which the intervention program will be developed and implemented, plays a significant role in either hindering or facilitating the desired changes. For instance, female relatives can support a woman's weight management by providing positive assistance, such as shopping for groceries and cooking healthy meals together. However, the food preferences of family members, particularly senior family members and male partners, have a positive association with the types of food purchased, prepared, and consumed at home (Vanstone et al. 2017). Several studies have indicated that in Vietnam, family members, including husbands, might influence expectant mothers by

exerting pressure to either increase or decrease their food intake (Lundberg et al. 2012; Kavle and Landry, 2018). As outlined in Chapter 4, the findings of my present study emphasize that family members, especially female relatives like sisters, play a significant role in providing nutrition advice to pregnant women within their home environment. This dynamic can either act as a barrier or a facilitator for pregnant women's adherence to the nutrition advice received during the intervention program. Furthermore, the study revealed that Vietnamese pregnant women may also be influenced by recommendations from friends on social media or information found on the internet. Finally, Vietnamese pregnant women's access to a diverse range of foods may be influenced by the dietary preference of other family members.

6.3.2 Strategies

In this section, I conducted a literature review focusing on dietary interventions during pregnancy. The aim was to identify effective strategies for promoting behaviour changes related to healthy eating and weight management among pregnant women.

First, the integration of educational techniques into dietary interventions targeting expectant mothers is supported by compelling evidence. Research conducted in countries with low- and middle-income status, including Vietnam, demonstrates the effectiveness of antenatal nutrition education as a suitable intervention for enhancing maternal nutrition (Bhutta 2013; Vaivada 2017; Kavle et al. 2018). Multiple studies consistently report positive outcomes associated with prenatal nutrition education, highlighting its impact on improving pregnant women's awareness of nutrition (Zangi 2014) and subsequently leading to significant improvements in nutrient intake (Ota et al. 2015). The positive influence of nutrition education on nutrition awareness and nutrient intake suggests its value in promoting healthier eating behaviors during pregnancy. Furthermore, additional studies confirm the significant association between nutrition education and improved pregnancy outcomes (Garg and Kashyap 2006; Everette 2009; Nehring et al. 2011). By equipping women with the necessary knowledge and resources, nutrition education can contribute to improved maternal nutrition, leading to healthier pregnancies, and potentially reducing the risk of complications. This aligns with the broader objective of enhancing overall maternal and child well-being and aligns with global efforts to improve maternal and child health outcomes, particularly in low- and middle-income countries.

Education is also identified as an important component in smartphone application-based dietary interventions during pregnancy (Overdijkink et al. 2018). Although the effectiveness of studies varies, most of the studies were found to be acceptable and positive in increasing

fruit and vegetable intakes and maintaining healthy gestational weight gain. My hypothesis was that pregnant women would become more aware, knowledgeable, self-confident, and perceive social norms differently as a result of exposure to the program. The determinants described above, consequently, would encourage pregnant women to actions to improve the diversity of their diets, take dietary supplements as recommended, and encourage their partners to participate in pregnancy-related activities. Thus, the theory of planned behaviour (TPB) will be used. TPB is one of the behaviours change theories that is widely used in nutrition education (Hackman et al. 2014). The theory suggests that intention is the most significant predictor of behaviour. As a result, one's intention is influenced by three constructs, attitude towards the behaviour, subjective norm (perceived social pressure to do the behaviour), and perceived behavioural control (perceived ease or difficulty of doing the behaviour). As seen in Figure 10 of a logic model for the intervention program, these techniques that are drawn from the taxonomy of behaviour change techniques identified by Michie et al. (2011) will be used to prompt these constructs, such as providing knowledge to the link between behaviour and health, the consequences of behaviour, providing information about how other people do, think or judge, and providing instructions to how to do. These techniques used in the intervention program have been well-reported as potentially being associated with attitude, subjective norm, and or perceived behavioural control (Abraham et al. 2010), even in meta-analyses of the mobile application-based dietary interventions for pregnant women (Brown et al. 2019).

Second, it is important to note that while providing information is a necessary aspect of promoting behaviour change, it alone is not sufficient (Arlinghaus et al. 2017). The authors emphasised that the provision of information, which should be either tailored or confirmed by a trusted person (e.g., healthcare professionals), is important to make the behaviour change. I recognised that the support of healthcare professionals (HCPs) would be vital to provide verbal persuasion and problem-solving in relation to pregnant women's questions as well as tailored answers to their questions, which could difficultly be delivered through a single face-to-face session due to the time constraint, but more easily be delivered by an app intervention. Qualitative and quantitative studies demonstrated that the time constraint during prenatal visits is considered a major barrier to communication between HCPs and pregnant women (Lucas et al. 2014). Vietnamese pregnant women in my present study also revealed that they had little communication with their HCPs due to the prenatal visit time restriction (see Chapter 4). Notably, it is evident that increasing communication between HCPs and women regarding gestational weight gain and diet can positively influence their

eating habits and challenge cultural beliefs or misconceptions about food preferences during pregnancy (Kavle and Landry 2018).

Finally, another approach involves embracing Bandura's (1989) observational learning model. The idea centres around the concept that observing the experiences of a role model can impact the behaviour or attitude of the observer by eliciting positive emotional responses (Bandura, 1989; Stone, 2017). The process of modelling a new behaviour or attitude in the observer can be broken down into four essential components: attentiveness to the behaviour, retention of the behaviour, attempts to imitate it, and motivation (Stone, 2017). The entertainment-education approach, extensively documented by the United States Centers for Disease Control and Prevention (Parvanta, 2011), serves as a practical implementation of this model for diverse health behaviours. Bandura (1989) emphasized that observing others' behaviours in entertainment settings can cultivate a strong sense of self-efficacy, defined as "the belief in one's ability to organize and execute the actions required to achieve specific goals" (Bandura, 1989). Entertainment-education (EE) refers to the deliberate design and execution of media messages that simultaneously entertain and educate, with the aim of enhancing audience members' knowledge about educational issues (Singhal and Rogers, 2004, p. 5). Notably, the EE approach is further conceptualized as a persuasive process targeting individuals to promote prosocial issues through the provision of information or encouragement of healthy behaviours, or both (Moyer-Gusé, 2008). EE messages can be conveyed through various media channels, including screens (TV or smartphones), visual imagery (e.g., posters or infographics), printed materials (e.g., leaflets or handouts), and audio formats (e.g., radio or music) (Brown and Singhal, 1993). Empirical evidence substantiates the effectiveness of the EE approach in delivering health information. Shen and Han (2014) conducted a meta-analysis, analysing data from 22 studies on the utilization of EE messages across a range of health behaviours. The findings indicated that EE, irrespective of the communication types, significantly influenced the dissemination of health-related information and brought about changes in attitudes, with a more pronounced effect observed among male participants. Additionally, a systematic review by Houts et al. (2006) demonstrated that simple visuals can enhance health communication.

Thus, visually captivating, animated videos and infographics will be integrated into the intervention program's educational components. These engaging visuals will address topics and concerns relevant to both partners during pregnancy. The pregnant woman will be encouraged to watch these videos together with their male partner at home and engage in discussions about the content. This approach aims to facilitate effective communication,

foster better understanding, and knowledge-sharing between pregnant women and their male partners.

6.3.3 Hypotheses on how the intended outcomes will work.

There are three assumptions that could explain why my intervention program's chosen strategies should lead to the intended outcomes. First, the educational component of the program will allow pregnant women to increase their awareness of why they need to make the change and informing them of what they are able to change (Arlinghaus et al. 2017). This should encourage them to modify or consolidate positive beliefs and attitudes toward foods and gestational weight gain. Second, when pregnant women encounter an issue, they will self-monitor to seek answers from either a provided trust source of information or HCPs, which will increase pregnant women's problem-solving skills. It can then develop behaviour on seeking information from trusted sources. Lastly, as mentioned earlier, pregnant women observe the model's experience where both parents work together to maintain healthy eating, which may shape behaviour arousing positive emotional reactions (Stone 2017), so they can be aware of the role of both parents in proper diet during pregnancy.

6.4 Indicators of the intended outcomes

Pregnant women's exposure and engagement to the program interventions will be assessed by three indicators: (1) number of educational materials read, watched, and downloaded each day; (2) engagement to seek answers from the provided sources of information (the Q&A component); (3) participating in interactive communication with HCPs in the forum component via asking their own questions and viewing answers from other participants.

The effectiveness of improving diet and weight gain among pregnant women will be evaluated by two indicators. First, the knowledge of pregnant women will be assessed through a series of open-ended questions regarding their understanding of various foods, dietary diversity, and the types of food that should be consumed daily during pregnancy. Each question was assigned a score of 1 (correct) or 0 (incorrect), and the sum of these scores was used as the knowledge score. Second, the Food Frequency Questionnaire (FFQ), which had been validated for use in Vietnamese adults (Tran et al. 2013), and the Vietnamese Healthy Eating Index (Van et al. 2022) will be used to assess the quality of dietary intakes, particularly on essential micronutrients (e.g., iron, calcium, folic acids). All these assessments above will be conducted before and after the intervention program. Additionally, the amount of weight gain will be reported by pregnant women participants in each trimester and the amount will be assessed based on self-reported pre-pregnancy BMI

and compared with the standard guideline of Vietnam Ministry of Health (2017) on gestational weight gain for Vietnamese pregnant population.

To evaluate the effectiveness of communication between pregnant women and their male partners, surveys will be conducted at the beginning, middle, and end of the intervention program. These surveys will inquire about the frequency, quality, and satisfaction of their interactions, as well as the pregnant women's perceptions of their partner's support, involvement, and shared understanding.

6.5 Evaluating the logic model

Once I complete my doctoral degree, my research will progress to a feasibility study of the intervention. During the feasibility study, I will gather feedback from pregnant women on the intervention components and use this feedback to refine the logic model. To ensure the coherence of the logic model, I will discuss with all stakeholders and carefully consider their opinions to determine which elements to group or ungroup and to create a more cohesive logic model. Additionally, based on the logic model and identified strategies, workshop sessions or focus group discussions will be conducted with pregnant women and local healthcare providers to develop strategies that align with the target population's local perspectives. For example, the feature and structure of the program (e.g., length of a lesson, a structure of a recipe, time for a video, number of words for an informative text, and other visual features), the topics discussed, the learning activities, and the types of questions will be explored in these workshops or discussions. All these things will refine and modify the program theory in the logic model because a logic model is considered a learning tool (Knowlton and Phillips 2013).

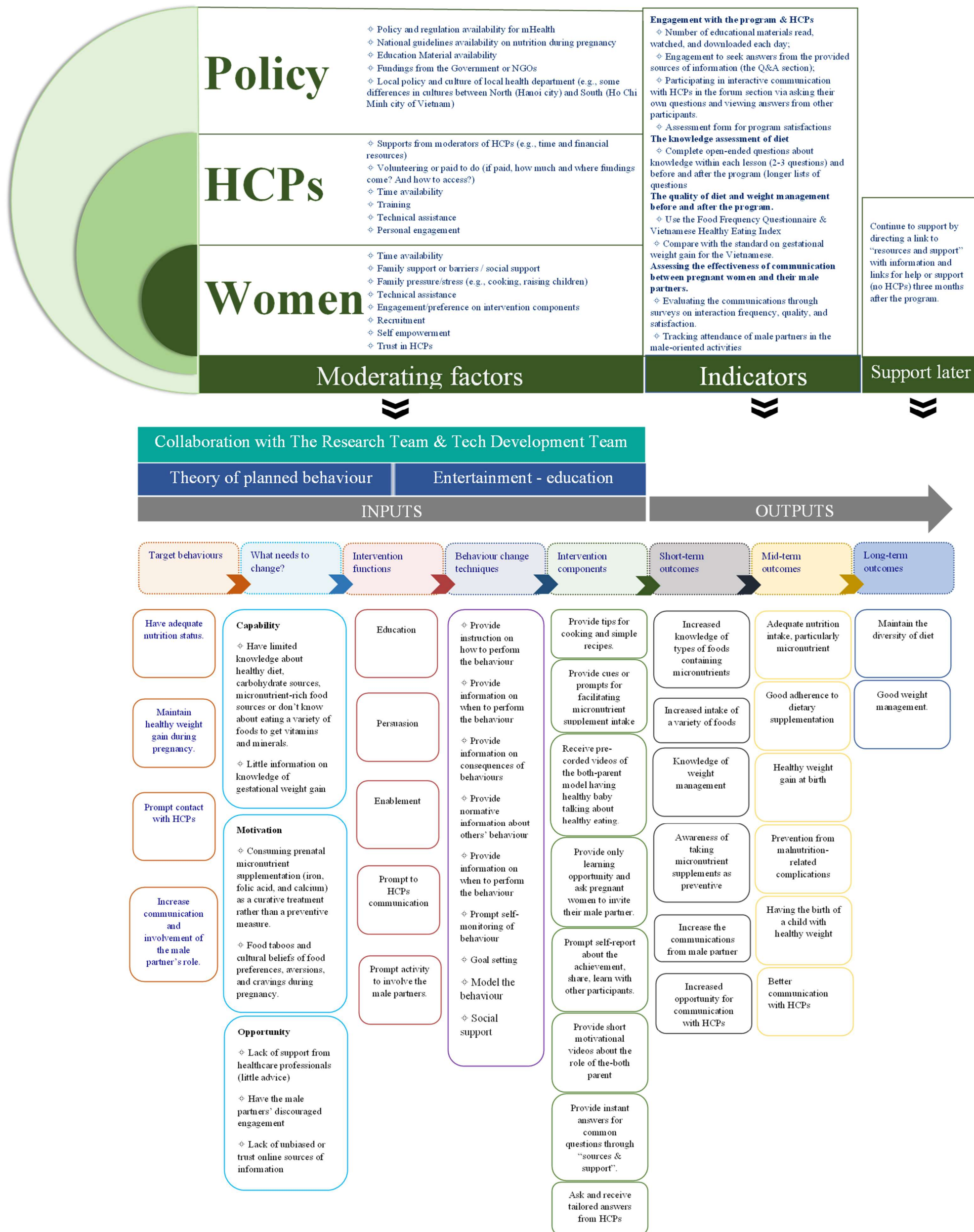


Figure 10: A logic model for the intervention program to promote healthy eating and weight gain for pregnant women in Vietnam.

Chapter 7: Conclusion, Implications for Clinical Practice and Future Research

7.1 Conclusion

The thesis has explored barriers and enablers toward healthy eating and gestational weight gain behaviours among Vietnamese women from various income backgrounds through my qualitative study using focus group interviews. The findings from the qualitative study have successfully addressed the research questions associated with the first aim of the thesis, as outlined in Chapter 3. First, Vietnamese women were driven by their maternal role and the desire to enhance their eating habits and manage weight gain during pregnancy. They recognized the importance of a healthy diet and appropriate weight gain for both their own well-being and the health of their unborn babies. The study has uncovered the factors that influence Vietnamese pregnant women during their transition towards adopting healthier behaviours. Insufficient knowledge as well as limited understanding of the risk of poor diet and inadequate or excessive gestational weight gain has been identified as barriers to healthy behaviours among Vietnamese pregnant women. Moreover, the existence of food culture (e.g., the 'Am and Duong' harmony) and food taboos have significantly influenced food restrictions or food preferences during pregnancy among Vietnamese women. The study has also revealed that Vietnamese women engaged in taking prenatal micronutrient supplements during pregnancy but adherence to the supplement intake varied. The level of adherence was influenced by women's perceptions of the therapeutic benefits associated with these supplements, including potential relief from pain, cramps, and support for better sleep. However, women were more likely to skip taking these supplements when they perceived a decrease in the expected benefits.

When it comes to seeking nutrition-related information, pregnant women in the study exhibited proactive self-care behaviour and actively engaged in knowledge acquisition about healthy eating and weight gain during pregnancy. However, they encountered challenges in obtaining comprehensive information from healthcare professionals. Pregnant women received limited advice and support from their healthcare providers regarding nutrition and managing gestational weight gain. Instead, women found value in engaging with informal sources such as the Internet, social media platforms like Facebook, and advice from family members. These sources were perceived as beneficial due to their accessibility, convenience, as well as the ability to gather information at one's own pace and seek reassurance from others' experiences. Nevertheless, it is important to consider that the information obtained from these informal sources is based on personal experiences and shared cultural beliefs, raising questions about its relatability and reliability. In addition, women expressed low

confidence in managing changes during pregnancy, including weight gain and morning sickness symptoms, which could have negative consequences for seeking assistance and making dietary behaviour changes. Insufficient communication and a lack of understanding from male partners also created challenges for women in having their needs acknowledged and addressed during pregnancy.

Based on the findings from the qualitative study, I have developed a logic model for the development of a m-health intervention to enhance healthy eating and weight gain during pregnancy among Vietnamese women. The development of the logic model signifies the fulfilment of the second aim in the thesis (see Chapter 3). The logic model, detailed in Chapter 6, encompasses the various components of the intervention, and explores their potential efficacy in achieving the desired outcomes.

7.2 Strengths

There are strengths in this present study. This is the first study to explore views and motivations of pregnant women with mixed incomes in Vietnam regarding healthy eating and gestational weight gain. A few previous studies examined women's attitudes to adherence to prenatal-micronutrient supplements or breastfeeding, but no studies to date focus on healthy eating and weight gain among pregnant women in Vietnam. This present study has contributed to filling this gap in Vietnam.

This study is the first in Vietnam and one of the early studies in the world using both the COM-B model and the TDF domains as a qualitative approach to explore healthy eating and weight gain behaviour in the pregnant population. Based on the findings of the qualitative work, the present study has developed a logic model for the development of a theory-based intervention to promote healthy eating and weight gain among pregnant women in Vietnam. I hopefully expect that it will be the first theory-based intervention in Vietnam that targets behaviour changes towards healthy eating to prevent malnutrition among pregnant Vietnamese women.

The present study has evidenced the existence of the 'Am and Duong' harmony on the balance between 'cold and hot' foods and its effect on eating behaviours among Vietnamese women during pregnancy although there was no report about this for a long time since studies in 1981 by Manderson and Mathews. Moreover, the present study has successfully addressed a significant research gap concerning food taboos during pregnancy among Vietnamese women. This gap had not been previously documented, as highlighted in the systematic reviews conducted by Köhler et al (2018) and Köhler et al (2019).

7.3 Limitations

This present study has some limitations that need to be addressed. First, demographic information (e.g., ages, trimesters of pregnancy, occupations, medical conditions) primarily depends on research participants' self-reports, so it could not verify the accuracy of information. Moreover, most research participants were living in urban or suburban areas in Vietnam, so this study may lack the insight of women who were living in rural and mountain areas, to further explore their barriers to healthy eating and weight gain during pregnancy. The initial plan of this present study wanted to focus on pregnant women with low income in Vietnam. Due to the difficulties to reach this population during the COVID-19 pandemic, the present study has selected research participants with mixed-income. Additionally, the COVID-19 pandemic also might alter the lives of the research participants such as increased risk of stress, anxiety due to restrictive measures during lockdowns. Because of this, it could contribute to a few limitations in understanding the barriers among pregnant women. Finally, it is important to note the present study entirely recruited and interviewed research participants online. Thus, the information sources about the Internet that the participants provided were consequently higher than those provided by the general population. The online recruitment method used in this study may also has limited the representation of certain demographic groups who may have limited access to or proficiency with internet usage. This could result in a sample that is not fully representative of the entire target population.

It is also important to note some limitations resulting from the inability to carry out both triangulation and member checking (see Section 3.2.2.4.d), as well as the lack of integration of patient and public involvement (see Section 3.2.2.5) due to constraints in time and resources, further exacerbated by the challenges posed by the COVID-19 pandemic. The absence of triangulation and member checking could potentially introduce biases or limitations in the research findings since the practice of cross-checking data was not pursued. Additionally, the lack of PPI in this study may have constrained the depth and breadth of insights, potentially affecting the generalizability and relevance of the findings to a broader audience. While I acknowledge these limitations, I have plans for future research endeavours aimed at addressing these issues and improving the overall strength and inclusivity of the research process.

7.4 Implications for clinical practice

The implications of this thesis for clinical practice are significant. By identifying barriers and facilitators to healthy eating and weight gain during pregnancy among Vietnamese women, healthcare professionals can provide more tailored advice and support to pregnant

women. For example, the findings suggested that limited understanding of the role and diversity of a nutritious diet during pregnancy, encompassing sources of critical vitamins and minerals is a strong barrier for healthy eating during pregnancy among women. Healthcare professionals should provide comprehensive and culturally sensitive education on the importance of a healthy diet during pregnancy, including the sources of critical vitamins and minerals. They can use various educational materials, such as brochures, videos, or online resources, to educate women about the benefits of a healthy diet for both them and their unborn babies. Healthcare professionals can also engage women in interactive sessions to discuss and address their concerns and questions regarding a healthy diet during pregnancy.

Additionally, the thesis shed light on the prevalence of food taboos during pregnancy in Vietnam, highlighting the importance for healthcare professionals to consider them when providing dietary advice. It is crucial for them to approach this advice in a professional and non-judgmental manner, recognizing that the meaning and significance of food taboos may vary among individuals and communities. By acknowledging and working with these existing beliefs, healthcare professionals can provide more effective advice and support to promote a healthy diet during pregnancy for this population.

7.5 Future research

As mentioned earlier in Chapter 3, the findings from this thesis can inform the development of future interventions targeting healthy eating and weight gain during pregnancy for women in Vietnam, following the MRC framework for developing complex interventions (see Section 3.1). The next step involves conducting a feasibility study to explore the usability and acceptability of the intervention components and testing initial effects. The feasibility study will involve a pilot test of the intervention components to determine their usability and acceptability among the target population. The feasibility study will also test the initial effects of the intervention on participants' knowledge, attitudes, and behaviours related to healthy eating and weight gain during pregnancy. The intervention will be tailored to the unique cultural and social context of Vietnam, including the prevalence of food taboos and the limited understanding of the role and diversity of a nutritious diet during pregnancy. Strategies for overcoming these barriers, such as education programs, peer support groups, and individual counselling, will be developed and tested to determine their effectiveness. The logic model developed in Chapter 6 will guide the development and testing of the intervention components and strategies. The findings of the feasibility study will be used to refine and improve the intervention before conducting a larger scale randomized controlled

trial. The development of an effective intervention will have significant implications for improving the health outcomes of pregnant women and their infants in Vietnam.

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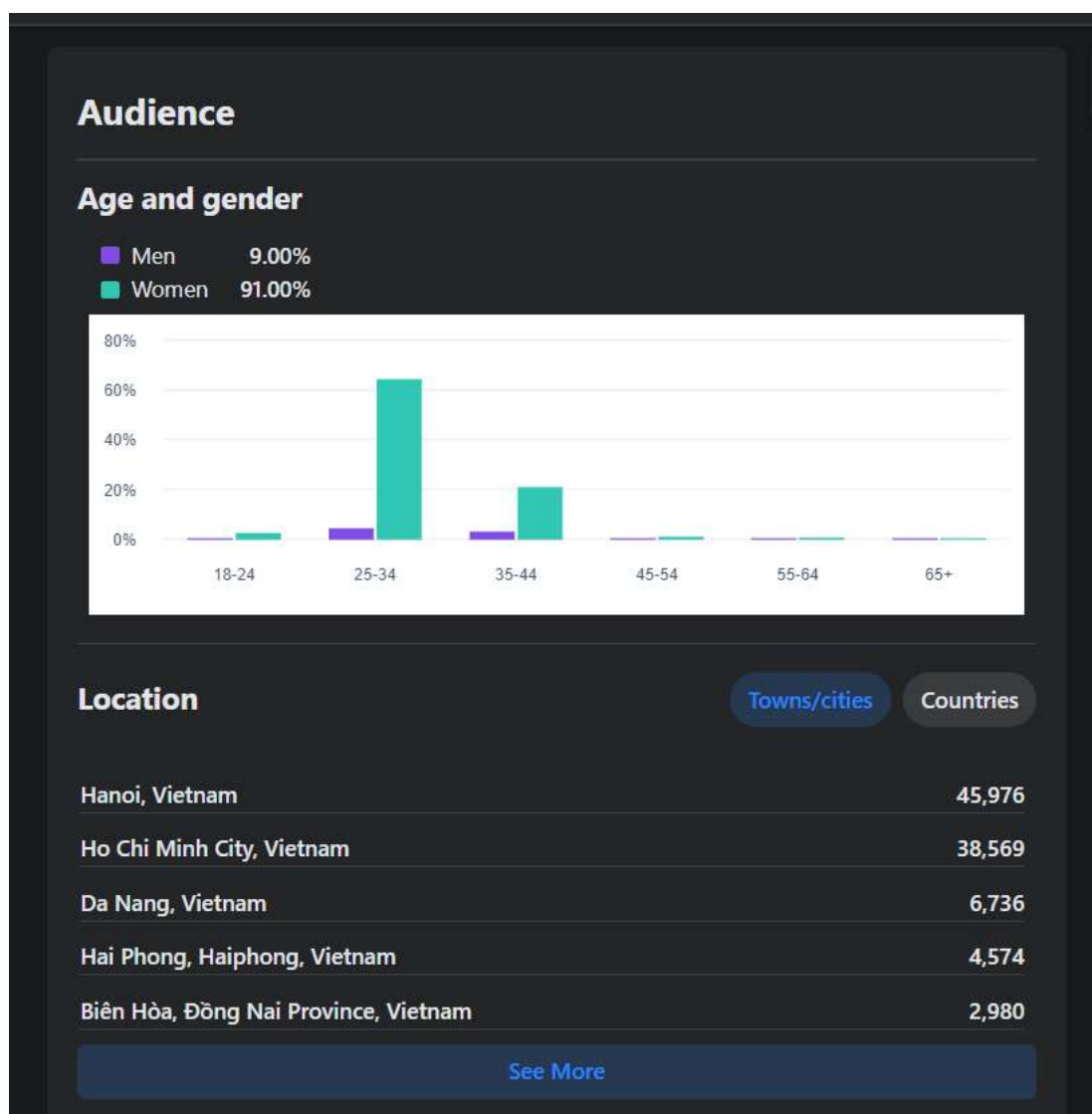
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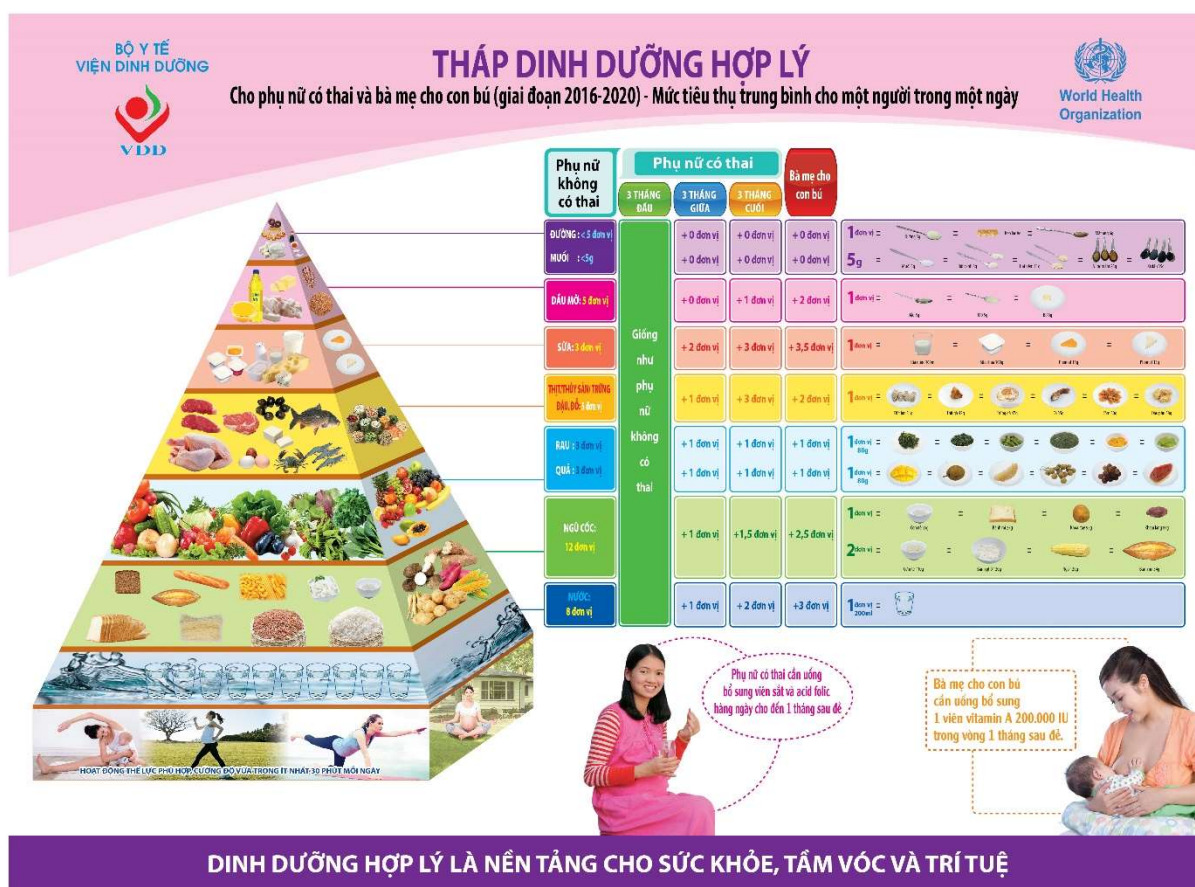
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Appendices

Appendix 1: Summary of my blog page's followers



Appendix 2: The Vietnamese FBDGs for the pregnant population (adapted from National Institute of Nutrition)





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Participant Information Sheet – Focus Group Interviews

[Translated into Vietnamese]

Study Title: Talking about diet during pregnancy.

I would like to invite you to join a doctoral study at the University of Stirling. Before deciding, I want to tell you what the study is, why the study is important and what you will do if you take part. Please take time to read this information sheet and discuss it with your family or friends if you wish. Do not hesitate to ask me any questions about the study.

❖ **Why have I been chosen?**

I am inviting Vietnamese women aged 18 to 44 who are pregnant and facing economic challenges, to take part in the study, and I hope to have around 20 women take part.

❖ **Do I have to take part?**

No, it all depends on you. Whether you participate or not will not affect your care during pregnancy. If you decide to join the study, please provide a consent form and fill in a 3-minute questionnaire here:

<https://cnfzone.com/nghiencuudinhduongmangthai>

You always can withdraw from the study at any time without giving a reason. To withdraw from the study, please email or text me at hoang.anh.nguyen@stir.ac.uk or 082 335x xxx with your name and the word 'withdraw'.

❖ **What is the aim of the research project?**

The purpose of this study is to help understand the perspectives of women in Vietnam on eating during their pregnancy. This will help me to develop a future effective intervention to improve diet quality for Vietnamese during pregnancy.

❖ **What will happen to me if I take part?**

You are being asked to take part in a conversation via a Messenger Rooms of Facebook to share your perspectives of diet during pregnancy with myself and 4-6 other participants. If you consent to the study, you agree to be audio-recorded during the conversation. The recording is important to ensure that I do not miss any information you have provided. During the conversation, I will ask you about your pregnancy, eating habits, weight changes, information and support sources. The length of the conversation is about 90 minutes, depending on what people have to say. After the conversation, you will receive a 100,000 VND gift voucher as a thank you and recognition of your time.

❖ **Will my taking part in this study be kept confidential?**

All the information recorded will be strictly confidential and kept in accordance with the UK law Government data, and used only by researchers working within the research team. Data from the study will be stored anonymously and destroyed 10 years after study completion.

❖ **Why should I take part in the study?**

Your views and experiences of eating during pregnancy are important for developing effective support to improve diet quality for pregnancy of Vietnamese in the future. I also would like to find out your opinions about ways of applying the nutrition information into your dietary practice. I need to do studies such as this one to make sure that the views of pregnant women like you are included in how the interventions are delivered in the future.

❖ **What will happen to the results of the research study?**

The results from the interviews with pregnant women will be used by me as the main researcher, to develop components of effective interventions to improve diet quality for Vietnamese pregnancy in the future. The interesting findings from the interviews will also be included in a study report for the University of Stirling and may also be written up for publication in academic journals. This is so that the findings can be made known to other researchers who might be intending to do similar work. You are not identifiable in any documents/data in the reports or publications.

❖ **Would you like more information?**

More information about the study is available from:

Hoang Anh Nguyen, University of Stirling,

Tel: 082335x xxx

e-mail:

hoang.anh.nguyen@stir.ac.uk

Appendix 4: An eligible questionnaire [translated into Vietnamese]

1. Contact information

Your name:

Year of Birth:

Phone:

City/province of residence:

2. Are you currently pregnant? Yes or No.

3. Is this your first pregnancy? Yes or No.

4. Have you had regular consultations with doctors to monitor and manage your diagnosed medical condition throughout your pregnancy? Yes or No.

5. In which trimester of pregnancy are you currently? 1st trimester; 2nd trimester; 3rd trimester

Appendix 5: Keywords and search terms

Keywords	Synonyms and related concepts
Pregnant woman	Pregnant woman, mother-to-be, expectant mother, expecting mother.
Pregnancy	Gestation, expecting, maternal, antenatal, prenatal, gravid, conception, fertility, trimester, postpartum, childbirth, obstetrics, prenatal care, maternal health, reproductive health, prenatal development, maternal well-being, pregnancy complications, maternal nutrition, pregnancy outcomes, maternal mortality, prenatal screening, foetal development.
Foetus or fetus	Foetus, unborn child, developing offspring, prenatal stage, foetal development, embryonic period, intrauterine, prenatal life, foetal growth, foetal stage, prenatal development, foetal health, foetal viability, foetal well-being, gestational age, foetal anatomy, foetal physiology, foetal monitoring, foetal ultrasound, foetal movements.
Maternal nutrition	Antenatal nutrition, prenatal nutrition, nutrition during pregnancy, maternal nourishment, prenatal diet, pregnancy nutrition, dietary intake during pregnancy, food consumption in gestation, maternal dietary practices, nutrition during antenatal period, dietary requirements in pregnancy, eating habits during pregnancy, pregnancy food choices, nutritional needs during gestation, dietary guidelines for pregnant women, healthy eating in pregnancy, nutrient intake in pregnancy, balanced diet in pregnancy, prenatal nutrition guidelines, diet and pregnancy outcomes, nutrition during the prenatal phase.
Pregnancy nutrition knowledge	Maternal dietary awareness, understanding of nutrition during gestation
Gestational weight gain	Gestational weight gain, pregnancy weight gain, maternal weight gain, weight gain during pregnancy, weight changes in pregnancy, pregnancy pounds, weight increase during gestation, maternal weight changes, maternal weight management, weight gain guidelines during pregnancy, weight gain recommendations in pregnancy, weight gain patterns during gestation, weight gain norms in pregnancy, gestational body weight changes, weight gain during the antenatal period.
Cultural beliefs	Cultural values, cultural norms, cultural traditions, cultural ideologies, cultural customs, cultural practices, cultural perspectives, cultural attitudes
Dietary behaviours	Eating habits, food choices, nutritional practices, dietary patterns, food consumption behaviours, dietary routines, eating styles, nutrition behaviours, food preferences, dietary habits, dietary practices, meal

	behaviours, food intake patterns, eating rituals, nutritional behaviours, dietary preferences, food-related behaviours, eating strategies, food selection habits.
Policy	strategy, plan, governance, regulation, legislation, rules, directives, agendas, decision
Guideline	Recommendations, directives, advice, suggestions, instructions, protocols, standards, procedures.
Micronutrient	Micronutrients, essential nutrients, vitamins, minerals, trace elements, nutritional elements, microminerals, micronutrient deficiencies, micronutrient intake, micronutrient absorption, micronutrient requirements, micronutrient status, micronutrient supplementation, micronutrient-rich foods, micronutrient interactions, micronutrient bioavailability, micronutrient metabolism, micronutrient transport, micronutrient sources, micronutrient assessment, essential elements, trace nutrients, dietary minerals, essential vitamins, minor nutrients, nutritional trace elements, essential trace minerals, key vitamins and minerals, vital micronutrients
Dietary restrictions	Food taboos, dietary restrictions, cultural food prohibitions, forbidden foods, prohibited dietary practices, culinary restrictions, eating taboos, food avoidance, dietary taboos, food rituals, food customs, traditional dietary restrictions, cultural dietary practices, food aversions.

Appendix 6

A focus group discussion topic guide

[to be translated into Vietnamese]

Introduction: about 5-8 minutes

A brief Introduction of myself, as the main researcher of this study. A brief introduction of the study and its aims and remind participants of being recorded.

Main discussion: 45-60 minutes

Key questions in the focus group interview guide

Summary of key questions

Topic 1: Concerns, beliefs and attitudes towards diet, nutrition, weight gain during pregnancy

- Have your eating habits changed since you got pregnant?
- What do think a healthy diet in pregnancy is like?
- What do you think about the well-known saying "eating for two when you are pregnant"?
- I am interested in our traditional food beliefs and food restrictions during pregnancy. Do you know anything about these? Do you follow them?
- Do you take folic acid? Do you think this is important during pregnancy? Do you take any other supplements?
- Do you think your diet is healthy now?
- What might get in the way of eating healthier?
- Do you feel like you have control over what you eat and the amount you eat?
- Have you noticed any changes in your weight since becoming pregnant?
- How do you feel about the changes in your weight during pregnancy?

Topic 2: Nutrition-related information seeking behaviour.

I would like to gather information during my study about what women want and need in terms of diet-related information in pregnancy and I would like to develop a website in future. So, I would really be interested in your views on this.

- Where did you obtain all your nutrition-related information?
- Among the information sources you have quoted, are there some sources that you trust more than others? (Why do you trust them?)
- What type of nutrition information are you looking for?
- What makes one website more attractive to you than another? (Refer to pre-circulated printouts of websites to prompt discussion.)

Probing questions: to clarify participant responses and guide the discussion

Can you tell me more about that?

Can you help me understand that better?

Appendix 7:

Consent form [Translated into Vietnamese]



PARTICIPANT CONSENT FORM

Title of Project: Talking about diet in pregnancy

Researcher: Hoang Anh Nguyen

Please
tick box

1. I confirm that I have read and understand the information sheet in this link for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time during the study period, without giving any reason. If I decide to withdraw from the study my data will be not be used.

☐

3. I understand that my participation in this study will be anonymous and data will be stored on password protected university computers.

☐

4. I understand that if some of my views are quoted in a report or published papers, this will be done in a way that ensures that I cannot be identified.

☐

5. I understand that my views will be audio recorded for the purpose of the study and that any recordings will be destroyed at the end of the study. Anonymised transcripts of the recordings will be kept for a period of 10 years to ensure accurate reporting in any future publications.

☐

6. I agree to take part in the above study.

☐

7. I would like to receive summary results of the above study.

☐

Type your full name and submit.

Appendix 8

Ethics approval



University of Stirling
Cottrell 3B1
Stirling
FK9 4LA

02/03/2021

Dear Hoang Anh

Ethics Application Form : [Healthy Eating during Pregnancy: An Exploratory Study in Vietnam 0656](#)

Thank you for your submission of the above ethics application and subsequent amendments.

The ethical approaches of this project have been approved and you can now proceed with your project.

Please note that should any of your proposal change, a further amendment submission will be necessary.

If you have any further queries, please do not hesitate to contact the Panel by email to ethics@stir.ac.uk

Yours sincerely,

General University Ethics Panel

Appendix 9: A draft of a paper ready for publication

Barriers and Enablers Toward Healthy Eating and Weight Gain Among Pregnant Women in Vietnam: An Analysis Informed by The Theoretical Domains Framework and COM-B Model

Anh Nguyen Hoang

Faculty of Health Sciences and Sport, University of Stirling, Scotland, United Kingdom

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Abstract

Background: Undernutrition and inadequate weight gain during pregnancy can harm mothers and babies in the short and long term. In Vietnam, 50% of pregnant women lack essential nutrients, and 30% do not gain enough weight. However, few interventions have successfully addressed this issue. Knowledge about the factors influencing healthy eating and weight gain during pregnancy in Vietnam is insufficient. This study aimed to identify barriers and facilitators for healthy eating and weight gain in pregnant Vietnamese women.

Methods: This qualitative study collected data from 20 pregnant Vietnamese women via virtual focus groups. The discussions were audio-recorded and translated into English for thematic analysis. The study utilized the Capability, Opportunity, Motivation to Behaviour model and theoretical domains framework to map the identified themes.

Results: Three key aspects- capabilities, opportunities, and motivations- provide insight into healthy eating and weight gain behaviours. The analysis revealed that pregnant women, despite being aware of the benefits of healthy eating and weight gain during pregnancy, had limited knowledge about specific food sources and the consequences of inadequate weight gain and micronutrient deficiencies. Additionally, inconsistent adherence to prenatal micronutrient supplements stemmed from misconceptions about their preventive benefits. Pregnant women demonstrated self-care and actively sought information about healthy eating and weight gain during pregnancy but faced challenges in obtaining comprehensive information from healthcare professionals. Instead, they relied on informal sources such as social media and advice from family members, finding them accessible and convenient for gathering information and seeking reassurance from others' experiences. However, the reliability and trustworthiness of information from these informal sources, rooted in personal experiences and cultural beliefs like food beliefs and taboos, underscored the significant influence of social and cultural factors on knowledge acquisition and decision-making. The analyses emphasized the necessity for culturally sensitive interventions to improve healthy eating and weight gain during pregnancy in Vietnam.

Conclusion: The study identified factors affecting healthy eating and weight gain during pregnancy in Vietnam. These can either help or hinder women in achieving appropriate weight gain, and healthy eating. Future interventions and care should consider these factors when advising pregnant women on their diet and weight gain.

Introduction

Inadequate gestational weight gain (GWG) and undernutrition during pregnancy remain major public health issues in developing countries including Vietnam. These issues are linked to higher chances of health problems for both mothers and their unborn babies, in both the short and long term (Kheirouri and Alizadeh 2021). For example, inadequate GWG, regardless of prenatal body mass index (BMI), is linked to an increased chance of delivering a baby with a low birth weight and an adverse effect on pregnancy outcome (McDonald 2010; da Fonseca 2012). Women who are undernourished during pregnancy are less likely to achieve sufficient energy and nutrients required for their own health and well-being, as well as for the development of their foetus; consequently, they become more susceptible to infection and are at a higher risk for miscarriages, preterm births, and maternal mortality (Black et al. 2008; Mate et al. 2021). Furthermore, studies conducted in low-income and middle-income countries have been found that maternal undernutrition increases the risk of foetal growth restriction, which increases the risk of neonatal deaths and stunting by age two (Lee et al. 2017).

The World Health Organization (WHO) underscores the importance of prioritizing good nutrition during pregnancy, which involves following a well-balanced diet that provides all essential nutrients in appropriate amounts and proportions. By adhering to a nutritious eating plan, the risks of complications such as gestational diabetes, pre-eclampsia, and preterm birth can be mitigated, while simultaneously promoting optimal foetal growth and development. Despite these well-documented benefits, pregnant women in Vietnam frequently experience challenges related to undernutrition and insufficient GWG, as consistently highlighted in studies conducted across the country. Approximately 75% of pregnant women in north-eastern Vietnam did not gain the recommended weight during pregnancy, increasing the risk of having a small-for-gestational-age (SGA) baby. In major cities like Ha Noi, Hai Phong, and Ho Chi Minh City, around 50% of pregnant women did not meet the Recommended Nutrient Intake (RNI) for energy requirements. Micronutrient deficiencies, including folic acid, iron, vitamin A, and calcium, were prevalent among these pregnant women. Numerous studies conducted in suburban and rural areas of Vietnam consistently revealed a notable increase in the prevalence of micronutrient deficiencies, specifically in folic acid, iron, vitamin A, and calcium, among Vietnamese pregnant women (Laillou et al. 2012; Tu et al. 2014; Nguyen et al. 2018; Tran et al. 2019).

Previous dietary interventions aimed at improving maternal nutrition status and gestational weight gain in Vietnamese pregnant women have demonstrated limited effectiveness. These interventions primarily focused on prenatal multivitamin supplementation (Nguyen et al. 2019) or dietary modifications (Hoang et al. 2020), but they did not adequately address the psychological factors and behavioural mechanisms that are crucial for achieving the desired effects of the intervention. It is noteworthy that multiple factors such as family, health conditions (e.g., morning sickness), food taboos, and beliefs regarding the health benefits of dietary supplements have been also identified as influencers of dietary behaviours in pregnant women in previous studies (Kavle & Landry 2018; Martin et al. 2020; Mohamed et al. 2022), even when foods or dietary supplements are readily available. Additionally, male partners, grandmothers, and other family members are highly influential (Aubel 2012) and can either promote or deter the adoption of recommended practices during pregnancy (Nagata et al. 2012).

Accumulative evidence suggests that implementing interventions that target various factors influencing dietary behaviours during pregnancy can yield a substantial positive impact on maternal nutritional status. This, in turn, effectively reduces the occurrence of low birth weight (LBW), small for gestational age (SGA), and premature birth (Stevens et al. 2015; Gresham et al. 2016; Papathakis et al. 2016). Furthermore, utilising a theoretical framework to identify behaviour determinants can increase the effectiveness of interventions (Craig et al. 2008). Systematic reviews conducted in both developed and developing countries, focusing on the content of dietary behaviour interventions during pregnancy, have consistently found that interventions rooted in theoretical frameworks are more likely to facilitate the adoption of healthier eating habits and promote more appropriate gestational weight gain (GWG) throughout the entire duration of pregnancy (Hill et al. 2013; Beulen et al. 2020; Watson et al. 2023). Maternity care interventions can benefit from the application of various theoretical frameworks from health psychology, enabling women to make positive changes to their lifestyle behaviours (Flannery et al. 2018). Michie et al. (2011) developed the Capability, Opportunity, Motivation to Behaviour (COM-B) model to provide a theoretical framework for comprehending behaviour in the context. The COM-B model may primarily contribute to the development stage of the Medical Research Council's guidance-based interventions by identifying an evidence-based and/or developing theory (Michie, Atkins & West, 2014). "The COM-B model proposes that for any behaviour to occur a person must have the psychological and physical capability to perform the behaviour; the physical and social opportunity to engage in it and must be motivated to do so", as highlighted by Flannery et al (2018, p.3). Theoretical domains framework (TDF) maps onto the three central components of the COM-B and can be used alongside the COM-B to facilitate an in-depth understanding of the behaviour (Michie et al. 2005; Cane, O'Connor & Michie, 2012; Michie, Atkins & West, 2014). The utilization of the COM-B model and TDF has been employed to investigate behaviour and guide the development of interventions across various health-related behaviours, but to the best of my knowledge, no such endeavours have been undertaken specifically for promoting healthy eating and gestational weight gain among pregnant women in Vietnam. It is also noteworthy that no reported studies that have examined the factors influencing healthy eating and gestational weight gain specifically within this population. Thus, qualitative research proves valuable in situations where limited information exists about this population, as it helps in establishing a theoretical comprehension of the target behaviour.

The purpose of this study is to investigate the factors that support or hinder healthy eating and gestational weight gain behaviours in Vietnamese pregnant women. We will employ the TDF (Theoretical Domains Framework) or COM-B (Capability, Opportunity, Motivation-Behaviour) models to analyse these factors. The findings will be utilized to guide the creation of an intervention aimed at enhancing healthy eating habits and promoting appropriate gestational weight gain in this specific population.

Method

Study design

A qualitative study collected data from Vietnamese pregnant women via virtual focus groups. Ethical approval was obtained from the University of Stirling's Clinical Research Ethics Committee (ref: 0656, 02/03/21).

Sampling and recruitment

Recruitment advertisements were placed on Facebook to reach potential research participants. There was a link to a website to access the participant information about the study, the researcher's contact information, and an online enrolment site in a separate link. If an individual indicated an interest in joining the study, she could access the provided link at the bottom to visit the enrolment site, where she provided informed consent by ticking boxes, typing their name, and submitting. To be eligible for participation, individuals must meet the following criteria: they must be pregnant women aged 18 or above, residing in Vietnam, and without a diagnosed medical condition that requires specific dietary or medication recommendations from healthcare professionals. Each research participant received an electronic 100,000 VND- gift voucher as a thank you and recognition for their time at the end of the study.

Process of focus group discussion

Once informed consent to the study, research participants were invited to the focus groups via their email or phone number that they provided. Online focus groups were conducted online via Messenger Rooms, Facebook's a video conferencing feature, under a private Facebook group with authorisation to join. All focus group discussions were conducted in the Vietnamese language and were audio-recorded by a good-quality digital recorder via a wireless system.

Data analysis

Focus group discussions were translated into English for analysis. NVivo software version 12 was utilized to support data analysis. A thematic analysis (Braun and Clarke 2006; 2019) was employed to analyses the data. An inductive thematic analysis was conducted to identify new emerging themes. These emerging themes were subsequently organized and categorized using the TDF and COM-B model. During the process, each transcript was thoroughly read and re-read multiple times to gain a comprehensive understanding of the data.

Results

Participants' characteristics

Out of the pool of twenty-two eligible pregnant women who willingly agreed to participate in the study and provided completed consent forms, two individuals ultimately did not attend. One participant had a change of mind, while another faced difficulty concerning child care availability. Consequently, the study consisted of a total of 20 participants, and five distinct focus groups were conducted, accommodating 4-6 participants each. Table 1 provides a summary of the participants' demographic information. Participants predominantly resided in Hanoi (45%) and Ho Chi Minh City (35%). Most of participants were in their third trimester of pregnancy (65%) and lived in the family home of their husband (60%). A half of participants were first-time mothers-to-be.

Table 1: Participants' demographic information

N (20)	
Age in years, mean (SD)	28 (3.6)
First pregnancy (%)	50%
Residents ▪ Hanoi ▪ Ho Chi Minh ▪ Danang ▪ Others	45% 35% 10% 10%
Trimester of pregnancy (%) ▪ The first trimester ▪ The second trimester ▪ The third trimester	5% 30% 65%
Unintended pregnancy (%)	10%
Whom pregnant women live with (%) ▪ Husband only ▪ Husband and the parent of husband ▪ Husband and their own parent	30% 60% 10%
Occupation (%) ▪ Housewife/ unemployed ▪ Self-employed ▪ Employed	25% 20% 55%

Factors influencing healthy eating and weight gain behaviours.

The behaviours of Vietnamese pregnant women about healthy eating and weight gain were organised using the COM-B model and TDF. Themes in all three aspects of the COM-B model including capabilities, opportunities, and motivations were laid out below.

Capability**Knowledge****Limited knowledge of nutrition and gestational weight gain**

Through the analysis of the focus group discussions with Vietnamese pregnant women, it became evident that their understanding of the crucial role nutrition and food play in providing essential minerals and vitamins during pregnancy was incomplete and varied. Women acknowledged the importance of micronutrients, but their awareness of specific sources of micronutrients was limited, and many failed to recognize that these minerals and vitamins can be found in various foods. For example, participants identified sources of key micronutrients such as folic acid in nuts and vitamin C in oranges and guavas, but demonstrated limited knowledge of other foods that contained these nutrients. The

participants were familiar with iron supplements but demonstrated limited understanding of the presence of iron in food sources. Even though the participants were familiar with iron supplements, they displayed a limited understanding of the critical role that iron plays in maintaining a healthy pregnancy.

“I am not sure why the iron supplement is given.” (Group 1)

Despite acknowledging the importance of micronutrients in maintaining a healthy pregnancy, the analysis of the focus groups discussions revealed the participants relied predominantly on supplements instead of incorporating micronutrient-rich foods into their daily diet.

“I could not eat anything in my first trimester, but I didn’t try to eat. I thought my baby only needed iron and calcium enough in this period, so I only took these supplements instead.” (Group 4)

In addition, most participants held a misconception about the relationship between sugar and carbohydrate intake and the risk of developing gestational diabetes mellitus (GDM), which led to the avoidance of certain foods. For example, some participants avoided or limited certain foods such as sugar, fruits, and rice during their pregnancy to prevent the risk of developing GDM because they failed to distinguish between sugar and other types of carbohydrates. Some fruits were thought as a sugary food and were avoided to prevent GDM, when in fact, fruits are an important source of vitamins and micronutrients for pregnant women. Additionally, a few women in the focus groups also held a misconception that the frequency of consuming some amounts of certain food (e.g., seafood) could put them at the possible risk of GDM. As noted by one participant

“I much prefer to eat seafood, but I wondered if or not seafood causes gestational diabetes. However, I should eat it in moderation as well.” (Group 4)

Pregnant women demonstrated an understanding of the importance of gaining weight during pregnancy, but they lacked clarity on the specific amount. Participants were unaware of the appropriate weight gain based on their prenatal BMI. Most participants noted that 10-12 kilos of weight gain during pregnancy are optimal although they self-reported themselves as overweight or underweight. It is noteworthy that this amount of weight gain is for those who have healthy prenatal BMI. As one participant shared,

“I don’t want to gain weight too much. I think no more than 10 kilos is okay [...] my body is more prone to being overweight than others” (Group 3)

The analysis from the focus groups also shed light on the uncertainty expressed by pregnant women regarding the ideal weight they should aim to gain during pregnancy. Notably, these women held the expectation of gaining a similar amount of weight as they did in their previous pregnancy.

“My body looks thin, and it can be very difficult for us to get body fat anyways. If you ask me, I just want to gain the same weight as my previous pregnancy, about 12 kilos, to get my baby to have a healthy weight at birth like my first son.” (Group 5)

Skills

Display Self-reliance and self-care

Pregnant women exhibited a remarkable level of self-reliance and independence when it came to managing their health and seeking out information. They actively took charge of their own well-being and sought out reliable information to make informed decisions. Their autonomy was evident in their proactive approach towards seeking health-related information and their determination to make informed choices for themselves and their pregnancies. This demonstrated a strong sense of self-efficacy and a willingness to take ownership of their health and well-being during pregnancy. One participant shared.

"I prefer to research things on my own before making a decision. I think it's important to have accurate information, especially during pregnancy."

The pregnant women in Vietnam were so motivated to gather accurate information about their health that they even conducted their own research. They recognized the significance of acquiring reliable information and were willing to invest time and effort to ensure that they had access to the right resources. As one participant described, she had experienced discomfort after eating and sought advice from her doctor and friends. However, when the advice didn't work, she turned to social media groups for support. One woman shared as below.

"One day I don't chew foods carefully, and right then my body feels hot. I also asked my doctor and my friends for advice. They advised me to drink more water, but it did not help a lot. I've recently found that I'm not alone with these symptoms. There are a few groups of pregnant women like me on Facebook sharing their experiences and solutions. They suggested me divide my meals into smaller meals, like 5-7 meals a day, as well as chewing food and eating slowly while eating. For me, it significantly relieves these symptoms." (Participant 18)

The pregnant women's online search capabilities reinforced their inclination towards self-care and independent efforts in seeking self-help. Women searched for nutrition information online, with the majority expressing confidence in using Google as their primary search engine and demonstrated basic skills in locating information from a variety of online sources, including the websites of local health departments and social media platforms.

It was noteworthy that women also expressed concerns about the difficulty of understanding the information they retrieved while searching on the internet. As one participant noted, searching online can lead to an "information maze" (Participant 17). This difficulty may be influenced by factors such as education background and health literacy level. Nevertheless, some participants employed different strategies to comprehend the retrieved information, such as seeking help from others. As one participant suggested:

"I'm more likely to go to Google and type my question. If I didn't find my answer, I used "Hello Doctor" which is a doctor hub. I can request a question on this page and get an answer from a doctor afterwards." (Group 3)

Opportunity

Information seeking behaviour and the use of the internet and Facebook.

Pregnant women in Vietnam were proactive in seeking out information related to their health and were eager to make informed decisions. They found the internet and social media more available and accessible to locate immediately at least a solution to their nutrition-related issues.

"I always turn to the internet and social media whenever I have nutrition-related questions during pregnancy. It's just so convenient and readily available. I can quickly find solutions or answers to my concerns without having to wait or rely on other sources." (Group 3)

Women also displayed a proactive attitude by actively seeking information about their nutritional requirements during pregnancy. They utilized online platforms, with a particular emphasis on Facebook groups, as valuable sources of information.

"I go to Facebook to see other mothers' experiences [...] I often have a chat with friends on Facebook about nutrition information I've read to hear their opinion, particularly those who experienced on the same thing." (Group 4)

Limited support from healthcare providers

Vietnamese pregnant women found that pregnant women identified nutrition as an essential part of prenatal care and doctor as trusted sources of information. Pregnant women expressed a desire for more detailed guidance on nutrition and diet from their doctors, as well as recommendations for reliable sources of information online. As one participant mentioned,

"A doctor is always the best person to reach out to for health-related issues, but for me, nutritional concerns are not enough to say it once. The doctor said everything, but they didn't ask me what I eat and told me what I should not eat." (Group 5)

However, despite their desire for the information provided by doctors, it was found that many participants expressed frustration with the lack of specific nutrition information provided by their doctors or other healthcare professionals. One participant stated,

"At 4 months pregnant, I sometimes experienced belly bloat after I eat certain foods. The symptom was worse as frequently as part of my meals. I asked my doctor about my symptoms, but she promptly replied to me that "it's okay". She seemed to be so busy that she could not wait for me to describe all symptoms I suffered. I also wanted to ask her whether the foods I was eating is related to my symptoms because my husband thought that I ate spoiled food. However, I didn't have any chance to ask her any further questions. She said that it is normal, but I thought that there was something wrong." (Group 5)

This viewpoint was expressed by multiple participants during the focus group interviews. The shared sentiment was that doctors were too busy to provide detailed information about nutrition and diet.

"My doctor only went over my symptoms, and she seemed to so busy to listen to me. While I was explaining why I was concerned about vitamin D, the doctor jumped in with all vitamins and supplements that were already prescribed, and then I was redirected." (Group 4)

In addition, it was also found that leaflets and brochures containing information on diet and nutrition were often distributed to pregnant women during antenatal consultations without adequate discussion or assessment of understanding. The analysis of the focus group discussion revealed that such an approach was not effective in influencing decision-making as many women reported that they were less likely to read these resources. As highlighted by one participant

“My doctor seemed not to give me a specific or direct answer to my question. Last month I was so stressed that I didn’t feel hungry. Swallowing food made me nauseous. I asked my doctor for help, but she quickly replied to me “okay, you know the baby will be getting all it needs”. Then she showed me a booklet with a food pyramid and said “you should consume like this” Blah, blah. I knew I should eat, but I just couldn’t. You know! the doctor has just bombarded with a must-eat list, that’s all.” (Group 5)

These findings underscore the importance of supplementing written information with discussion and interaction with healthcare professionals to maximize the effectiveness of the resources. Therefore, healthcare professionals should ensure that they engage in meaningful discussions with pregnant women and assess their level of understanding to support informed decision-making.

Supports from female family members and male partners.

Within the social circle of pregnant women, recommendations regarding nutrition often came from female members on both sides of their family, including their mother and sister. These suggestions were often based on personal experience or hearsay. Women tended to question the accuracy of information from older female family members, including their own mother or their husband's mother, perceiving them as outdated. Conversely, they considered their sisters as reliable sources if they could witness their sister's pregnancy as a positive and successful experience.

“I’ve switched to a multivitamin since the second trimester. My sister bought this multivitamin for me. She also only took it when getting pregnant. Her baby born at an ideal weight (about 3.8 kilos) was very healthy.” (Group 5)

The lack of communication and understanding from male partners regarding pregnancy and nutrition needs further compounded the challenges faced by women. This was particularly evident in dismissive attitudes towards concerns about nutrition over the need of the pregnant women. Such dynamics left women feeling unsupported and unheard during this crucial time.

"I experienced belly bloat after I eat certain foods. The symptom was worse as frequently as part of my meals. It's really frustrating when my partner completely dismissed my concerns and he often brushed off my worries, thinking I was exaggerated or unnecessary. I tried explaining how it was affecting my comfort and well-being, but he didn't take it seriously. It made me feel unheard and unsupported during this important time of my pregnancy." (Group 2)

Support from social network

Pregnant women were open to accepting new ideas about nutrition or food recipes from peers they connected with on the internet and social media, such as Facebook. They also found comfort in stories or experiences shared by other mothers in Facebook groups, which helped them navigate the challenges of pregnancy with greater ease.

“I am also a member of a Facebook group of over 10k moms to talk and get together for baby issues [...] When I visit a doctor, I sometimes would like him to talk about the pros and the cons as well as how I can benefit from certain supplements. I found these groups more comfortable to address these issues [...] If I have a question

associated with my pregnancy issues, I went round these groups and I could find myself in their cases and knew how they resolved it [...] I can learn from other moms' experiences. These groups provide me with a safe opportunity to engage with and discuss with my peers about my pregnancy issues. In these terms, it is very helpful too!" (Group 3)

In addition, women in the focus groups highlighted the importance of seeking reassurance from the experiences of other women when searching for information. They emphasized the value of connecting with other women's experiences, as it can be reassuring and provide a sense of support. As one participant stated, she was more likely to share or talk to other women about her experiences to seek comfort in the experiences of other women who are in similar situations.

"I sometimes experienced belly bloat after I eat certain foods [...] I thought that there was something wrong. I went online to find an answer for myself. In Facebook groups, some women's symptoms were similar to what I had. They said that the body during pregnancy may be sensitive to some foods such as tomatoes, oranges and bread that cause bloating. I found that I also had these foods in my meals, so I stopped eating them and the symptoms got better." (Group 5)

It was interesting to note that the significance of community and connection with other women in the process of seeking information. While it was presented earlier that women found comfort in sharing their own experiences of others and hearing from others, in this case, the emphasis was on women utilizing the experiences of others as a tool to inform their own research and decision-making.

Food cultures and taboos

Many pregnant women reported a belief in Chinese medicine that the balance of hot and cold elements in their diet can be important during pregnancy. According to this belief, cold and hot foods can have certain effects on the body, such as causing poor blood circulation in the uterus or constipation. However, there is little scientific evidence to support this belief, and it may be based more on anecdotal experiences and beliefs passed down through generations. Pregnant women might hear about this belief from friends or family members and tried it out themselves, even if they were not entirely sure of its effectiveness. As one participant described her experience about this belief.

"I still remember an unpleasant experience I suffered after eating a bowl of katuk soup at 2 months pregnant. My mom cooked it because she did not know about it before. I was getting a pain in my lower abdomen after eating it. Although the pain was mild, I was getting rather worried about what was wrong with my baby. I could not sleep until I met my doctor the next day." (Group 5)

These beliefs led to the avoidance of "cold" foods in the first trimester and "hot" foods in the third trimester among pregnant women, driven by concerns about miscarriage, bad blood circulation, constipation, and potential harm to the baby.

"Cool foods" such as katuk, mung bean, and mostly green vegetables are not good for our pregnancy because these foods can induce "poor" blood circulation in the uterus [...] I just would add some cool fruits such as unripe papaya, watermelon and banana. They are associated with miscarriage or bleeding if we eat them during the first 3 months." (Group 5)

Furthermore, pregnant women in Vietnam demonstrated a strong belief in a cause-and-effect relationship between specific food consumption and the health of their unborn baby. They attributed the concept of beauty and ugliness in their baby to certain foods, perceiving them as influential factors. Notably, many participants held the belief that consuming cola or guava could lead to the baby having an unattractive skin appearance. Conversely, they shared a common belief in the benefits of coconut water, including purifying the amniotic fluid and enhancing the baby's skin condition at birth, despite the absence of scientific evidence supporting these claims. For instance, one participant mentioned that drinking coconut water was believed to result in a fair-looking baby.

“I drank a glass of coconut water a day [...] In Vietnam, you know and many people want babies to be fair looking, not dark looking. It's thought that if you drink coconut water then your baby's going to be fair looking.” (Group 1)

Motivations

Being a mommy transition

Participants have considered pregnancy as a moment for thinking of and making healthier changes that are essential for their foetal development, therefore it would appear that pregnancy is an ideal ‘teachable moment’ for positive behaviour change. For example, pregnancy could essentially affect women’s lifestyle and nutrition behaviours later in their life. In this perspective, a pregnant woman in the focus group discussions has seen her pregnancy as an important turning point in her life that she was unaware of nutrition before.

“I have been skinny all my life. I never thought about it much but now I think it's affecting my baby. Getting pregnant, I'm sometimes extremely lethargic throughout the day. I think I don't get enough energy for both of us” (Group 5)

The analysis of the focus groups also revealed that participants, particularly first-time expectant mothers, made changes to their eating behaviour once they became pregnant. This included modifications such as avoiding low-nutrient foods and avoiding meal skipping. One participant shared how she made dietary changes to prioritize healthier food choices for herself and her baby.

“If you ask me there is any change in my diet since getting pregnant, I think I did not eat instant noodles anymore. I know that instant noodles do not have many nutrients. I must go to school by 7:00 every morning, so I do not have much time for kinds of stuffs such as cooking and taking my kid to school. Cooking instant noodles just fits my schedule in the mornings. Since getting pregnant, I felt nauseated once eating instant noodles, so I didn't want to eat anymore.” (Group 5)

Confidence in weight management during pregnancy

The analysis of the focus group discussions unveiled the factors that affect women's confidence in managing their weight during pregnancy. The inadequate knowledge surrounding weight management during pregnancy, undermined the confidence levels of pregnant women in effectively managing their gestational weight. This finding was consistent among first-time pregnant women. However, participants who had prior childbirth experiences and successful postpartum weight management exhibited confidence in managing their weight during pregnancy. One participant highlighted how her confidence in

managing weight during her current pregnancy increased after successfully implementing a weight loss plan following her previous pregnancy.

“I put on 20 kg during my first pregnancy. At 2 weeks postpartum, I was at 68 Kg weight but certainly not my pre-pregnancy shape (54 Kg). However, since doing Yoga, I lost 7 Kg, I was not in any hurry, but I was looking to get back in shape and be healthier than, at least before I was pregnant too. 9 months in, 9 months out is the way I looked at it.” (Group 4)

On the other hand, participants who experienced excessive weight gain in previous pregnancies or had past unsuccessful attempts to lose weight in prior pregnancies undermined their confidence in managing their weight during their current pregnancy. One participant expressed her feelings of frustration and a diminished confidence in effectively handling her weight during pregnancy.

“I gained 16 kilos. I don’t want to gain so much weight. I used to gain 25 kilos in my previous pregnancy, then it’s difficult to lose weight afterwards. Indeed, I did not return to a normal weight yet before having this baby. Thus, I put more and more weight on this baby. I think it’s about extra 10 kilos. It’s quite frustrating and shakes my confidence in being able to effectively handle my weight.” (Group 3)

Confidences of morning sickness symptoms

Most of the participants experienced morning sickness symptoms such as nausea and vomiting. It is worth noting that these experiences are widely prevalent during pregnancy, affecting up to 80% of pregnant women worldwide (Lee, 2011). These symptoms happened throughout their day, not in a specific pattern, but they became worse when women consumed food. A clear confirmation from participants in the focus group discussions is that they perceived the symptoms of morning sickness as a must-have sign of pregnancy in the first trimester, so they were well-prepared for this event by dietary modifications to relieve these symptoms of morning sickness.

“From the beginning to four months of pregnancy, I consumed very little because of the morning sickness, so I tried to eat anything that does not make me feel sick.” (Group 5)

Those, who did not have the symptoms during their pregnancy, are considered as lucky or special. A conversation among participants (Group 5) reinforced this.

Participant 1: *“my diet is as normal as usual: three meals a day because I didn’t have any symptoms of morning sickness. Until now, I don’t have any issues with eating.”*

Participant 2: *“You’re so lucky. From the beginning to four months pregnant, I consumed very little because of the morning sickness, so I tried to eat anything that does not make me feel sick. After the period of morning sickness, my eating became a little better.”*

Participant 3: *“Yes, me too. From the first to the third month, I also had morning sickness, so I ate less than usual.”*

However, pregnant women did not expect and were unprepared to deal with prolonged symptoms, so they became confused and unconfident to manage these prolonged symptoms as well as modify their diet.

“Some people said that morning sickness usually clears up by week 12 of your pregnancy, but I still have it until now [...] I believe I will feel better if I pass the 12 weeks of pregnancy. Honestly, I always expect to pass the 12 weeks of pregnancy every day. So disappointed! I’m still having symptoms now. I don’t know when the symptoms completely clear up.” (Group 4)

Belief in prenatal vitamins and dietary supplements

Many pregnant women believe that prenatal vitamins and dietary supplements additionally benefit the mother and the foetus’s diet during a pregnancy instead of diet alone. Women did not perceive intake of these supplements as a preventive measure or treatment for nutrient deficiencies or nutrition-related issues. Instead, they viewed the supplements as a form of medicine to treat an illness. This perception was evident through the experiences shared by the participants.

“Notably, I often had cramps in my legs during pregnancy start. In addition, I felt dizzy when I changed my head or body position or moved from a seated position to a standing position, which usually lasts a few seconds or minutes. When I took this multivitamin, these symptoms seemed to be most relieved.” (Group 5)

Women initiated to use the iron and calcium supplements when they felt physical symptoms such as pains or cramps in their previous pregnancy and will continue to use them as a preventive purpose in their current pregnancy.

“I used the calcium supplement for my first pregnancy. You know! It’s useful, at least for joint pains I suffered in my previous pregnancy, so now I’m taking it for my current pregnancy. Goodness, it still works.” (Group 4)

As a result, adherence to these supplements depended on perceived benefits. If the perceived benefits diminish or if women experience side effects, they may adopt a more lenient approach towards supplement adherence.

“My doctor also prescribed iron supplements [...] I also experienced stomach discomforts such as stomach upset, nausea, and constipation when taking iron pills. Now I’ve switched to a multivitamin. (Group 5)

Discussion

The study utilized the COM-B model and the TDF to organize the factors influencing healthy eating and weight gain behaviours among pregnant women in Vietnam. The findings identified barriers and facilitators in the capability, opportunity, and motivation aspects of the COM-B components. This approach aligns with a study by Flannery et al. (2018) in Ireland, which also utilized the COM-B model and TDF to explore barriers and motivators to physical activity among overweight or obese pregnant women.

Capability

Few Vietnamese women in the study were aware of the recommended weight gain or how to monitor it based on their prenatal BMI during pregnancy. They also had limited understanding of the risks associated with inadequate or excessive weight gain. Similarly, their knowledge of food sources and micronutrient deficiency risks was limited. Research shows that understanding the risks, valuing healthy weight gain and nutritious eating, and

acquiring knowledge can enhance their adherence to recommendations (Spronk et al. 2014; Wardle et al. 2016)).

In addition, pregnant women in the present study showed the high level of self-care and independence reflects the participants' capability to make informed choices for themselves and their babies, highlighting their active engagement in managing their health during pregnancy. The findings of the present study regarding the self-care practices among pregnant women demonstrated a resemblance to the results reported by Puspita et al. (2015) in their study on Indonesian women. Earlier study indicated that pregnant women engage in self-care through a range of behaviours, such as seeking health information, making dietary adjustments, participating in physical activities, prioritizing rest, and practicing meditation (Patterson et al. 1990; Hawkins et al. 1998). Consistent with these studies, the pregnant women included in the current study demonstrated proactive self-care in managing their health and acquiring information. Besides, Vietnamese pregnant women's confidence in using search engines like Google and their ability to locate information from various online sources, including websites and social media, are considered valuable skills in their capability. The internet has become popular for accessing health-related information during pregnancy, regardless of geographic location or economic development (Eysenbach et al. 2002; Lagan et al. 2010; Gao et al. 2013)). Research has demonstrated that many pregnant women rely on the internet as a source of information to address uncertainties and navigate decisions related to pregnancy (Song et al. 2012). According to a systematic review conducted by Sayakhot and Carolan-Olah (2016), the capability to navigate and utilize online sources empowers pregnant women to conveniently access a wealth of information at their own pace.

Opportunity

Online information sources are widely used and easily accessible to women in Vietnam due to the high internet penetration rate and smartphone ownership. The majority of daily online news consumers in Vietnam belong to the age group of 18 to 29 (Pew Research Centre, 2018). However, healthcare providers offered limited advice and support on diet and weight gain during pregnancy in this study. Time constraints and limited knowledge among healthcare providers were identified as contributing factors (Lucas et al., 2014). Improving communication between healthcare professionals and pregnant women can positively influence eating behaviour and address cultural beliefs (Kavle and Landry, 2018), potentially improving adherence to recommended dietary intakes during pregnancy (Caut, 2020).

In addition, the absence of effective communication and a limited understanding of their needs during pregnancy by their male partners also contributed to a sense of inadequate support among the pregnant women in this study. The findings of the present study regarding dissatisfaction with support from their partners among pregnant women demonstrated a resemblance to the results reported by Phoosuwan et al. (2020) in their study on Thai women. The findings also emphasised that the importance of connection with other women's experience to seek reassurance from the experiences of others as well as seeking information to make their own decision-making. Most of the women in the present study revealed that Facebook is a useful platform for them to exchange knowledge as well as to find support through their stressful pregnancy life. A study conducted by YouNet Media (2017) disclosed that 90% of Vietnamese mothers considered Facebook as the primary platform for sharing knowledge related to pregnancy, and birthing experiences.

The study identified the presence of food cultures and taboos among pregnant women in Vietnam, aligning with previous research on the influence of the 'Am and Duong' harmony on health behaviors (Lundberg & Trieu, 2011). The study found that the 'Am and Duong' harmony, focusing on the balance between 'cold and hot' foods, continues to influence pregnant women's dietary choices. Food taboos were also prevalent, such as the preference for coconut milk due to the belief in its positive impact on the baby's skin appearance. Coconut milk and sugar cane juice were found to have different meanings and taboos in Southeast Asian countries. Indonesian women associate sugar cane with making babies' ears watery, while Lao and Cambodian women believed that consuming coconut milk during pregnancy could lead to increased weight in their babies and delivery difficulties (Triratnawati et al., 2016; Holmes et al., 2007; Montesanti, 2011; de Sa et al., 2013).

Motivation

In term of motivation, Vietnamese women have increased motivation to improve their eating behaviours during pregnancy. This has often been seen among the pregnant population in previous studies (Lindqvist et al. 2017; O'Brien et al. 2017). This present study also demonstrated that women were also encouraged to adopt the new social role of a mother once they became pregnant. They indicated that their perceptions of the importance of a healthy diet for themselves and their fetuses contribute to their perceptions of being a 'good mother' when eating healthy food. However, they had low confidence in the management of pregnancy-related changes, such as weight gain or the symptoms of morning sickness. Low confidence in the management of changes during pregnancy should be negative consequences for seeking assistance and decision making as well as health behaviour, including nutrition (Pereira 2008).

In addition, the study found that Vietnamese women's adherence to prenatal micronutrient supplements during pregnancy varied, and their perceptions of the curative benefits of these supplements influenced their adherence. The study aligns with a previous study conducted in Vietnam by Nechitilo et al. (2016) and highlights the impact of women's misconception about the health benefits of these supplements on adherence. Lack of knowledge about micronutrients and relevant deficiencies was also identified as a barrier. Side effects, especially related to iron supplements, were reported as additional barriers. Unplanned pregnancy and not feeling the necessity of taking folic acid supplements were common reasons for non-adherence, as shown in previous studies (Bixenstine et al. 2015; Ezzeddin et al. 2019; Ikeda-Sakai et al. 2019).

Strengths and Limitations

This study has notable strengths. It is the first to explore barriers and facilitators to healthy eating and gestational weight gain in pregnant women with mixed incomes in Vietnam. It also pioneers the use of the COM-B model and TDF domains for qualitative analysis in Vietnam and globally. The research highlights the prevalence of food beliefs and taboos during pregnancy, emphasizing the need for healthcare professionals to consider them when providing dietary advice. By respecting and understanding these beliefs, healthcare providers can offer more effective support for promoting a healthy diet during pregnancy. However, the study has limitations, including a lack of representation from rural and mountain areas and potential bias in the online recruitment method, which may have excluded certain demographic groups with limited internet access or proficiency. Therefore, the sample may not fully represent the entire target population.

Conclusion

This study examines barriers and facilitators to healthy eating and weight gain during pregnancy among Vietnamese women from various income backgrounds. Women were motivated by their maternal role and the well-being of themselves and their unborn babies. Insufficient knowledge and limited understanding of the risks, cultural beliefs, and food taboos were identified as barriers to healthy behaviours. Women relied on informal sources for information, such as the internet and family advice. They demonstrated proactive self-care behaviour but lacked confidence in managing pregnancy changes. Limited communication and support from healthcare professionals and partners added to the challenges faced by pregnant women.

References

References are as listed above (see References)