DEVELOPMENT AND EVALUATION OF ANIMATED VIDEOS TO PROMOTE HEALTHY NUTRITION DURING PREGNANCY & EXCLUSIVE BREASTFEEDING FOR CHILDHOOD STUNTING PREVENTION

BY

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A dissertation submitted in fulfillment of the requirement for the degree of Master of Health Sciences (Health Promotion).

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March 2025

ABSTRACT

Stunting has a negative impact on children under five years old in both short and long terms, where maternal nutrition status during pregnancy is determined to be a crucial causative factor. However, education tools are limited, particularly in the digital format called for by the World Health Organization (WHO) to enable rapid information dissemination. Therefore, this study aimed to develop and evaluate a nutrition education module in the form of an animated video series on healthy maternal nutrition during pregnancy and exclusive breastfeeding to prevent child stunting.

This study utilised the design and developmental research (DDR) method, which has three stages: content analysis through a review of the literature and evidence-based practice guidelines or recommendations; evaluation of the storyboards and scripts by experts in relevant areas such as nutritionists, dietitians, and senior lecturers in nutrition and dietetics (N=6); and design and development of the videos by using a video animation software. The storyboards for the video were developed, and Bloom's Taxonomy was used as a reference. Then, the script of the videos was constructed based on learning objectives and contents from the storyboards. Next, the videos were developed using a selected animation software, such as Powtoon. Once completed, the video iterations were evaluated by multimedia experts in terms of language and voice, visual enhancement, content and organisation. Finally, the videos were evaluated among a subgroup of the target viewers which comprised women of childbearing age from 18 to 49 years (N=50). The participants were given a link for the videos with questionnaires through WhatsApp and email. The evaluation of its suitability, understandability, and actionability was conducted using the Suitability Assessment Method and Patient Education Materials Assessment Tools for Audio-Visual (PEMAT-A/V) questionnaires.

Four short video animations were produced on total energy and nutrient requirements for pregnant and breastfeeding mothers to avoid childhood stunting. The titles included 'Total energy and macronutrient requirements during pregnancy', 'Total energy and macronutrient requirements during exclusive breastfeeding', 'Vitamin requirements during pregnancy and exclusive breastfeeding', and 'Mineral requirements during pregnancy and exclusive breastfeeding'. The length of each video was between three and five minutes. The mean suitability score ± SD of the educational materials for video 1, video 2, video 3, and video 4 were 94 ± 6.6, 97 ±7.4, 98 ± 3.7 and 99 ± 3.1, respectively. The developed educational video was rated as "superior media" based on the SAM ratings. The understandability of videos 1, 2, 3 and 4 were found to average 96%, 98%, 99%, and 100%, respectively, whereas the overall actionability average was 95%, 99%, 99% and 99%, respectively.

In conclusion, the study showed the developed educational videos were good in suitability, understandability and actionability. These videos can serve as valuable tools for educating pregnant and breastfeeding mothers about their nutritional needs to prevent childhood stunting. Further research could explore the impact of these videos on actual dietary practices and health outcomes in targeted populations.

ملخص البحث

التقزم له تأثير سلبي على الأطفال تحت **سن الخامسة على المدى القصير والطويل، حيث يُعتبر وضع التغذية لدى الأمهات أثناء الحمل عاملاً مسببًا رئيسيًا. ومع ذلك، فإنّ أدوات التثقيف محدودة، لا سيما في الشكل الرقمي الذي توصي به منظمة الصحة العالمية؛ لتمكين نشر المعلومات بشكل سريع. لذلك، هدفت هذه الدراسة إلى تطوير وتقييم وحدة تثقيف غذائي في شكل سلسلة فيديوهات متحركة حول التغذية الصحية للأمهات أثناء الحمل والرضاعة الطبيعية الحصرية للوقاية من التقزم لدى الأطفال. استخدمت هذه الدراسة منهج البحث في التصميم والتطوير، الذي يتضمن ثلاث مراحل: تحليل المحتوى من خلال مراجعة الأدبيات والإرشادات أو التوصيات المستندة إلى الأدلة؛ وتقييم لوحات القصة والنصوص من قبل خبراء في المجالات ذات الصلة مثل أخصائيي التغذية، وأخصائيي الحمية الغذائية، وأساتذة التغذية وعلم الحمية (N=6)؛ وتصميم الفيديوهات وتطويرها باستخدام برامج الرسوم المتحركة. تمّ تطوير لوحات القصة للفيديوهات بالاعتماد على تصنيف بلوم للأهداف التعليمية. ثمّ تمّ بناء نصوص الفيديوهات استنادًا إلى الأهداف التعليمية والمحتويات المأخوذة من لوحات القصة. بعد ذلك، تمّ إنتاج الفيديوهات باستخدام برنامج رسوم متحركة مختار، مثل Powtoon. بمجرد الانتهاء، تمّ تقييم النسخ النهائية من الفيديوهات من قبل خبراء الوسائط المتعددة من حيث اللغة والصوت، والتحسينات**

البصرية، والمحتوى والتنظيم. وأخيرًا، تمّ تقييم الفيديوهات بين مجموعة فرعية من المشاهدين المستهدفين، وهم النساء في سن الإنجاب من 18 إلى 49 سنة (N=50). تمّ إرسال روابط الفيديوهات والاستبيانات عبر تطبيق واتساب، والبريد الإلكتروني. وتمّ تقييم ملاءمتها، ومدى فهمها، وقابليتها للتنفيذ باستخدام طريقة تقييم الملاءمة وأدوات تقييم مواد التثقيف الصحي للوسائط السمعية والبصرية (PEMAT-A/V). تمّ إنتاج أربعة فيديوهات متحركة قصيرة حول إجمالي متطلبات الطاقة والمغذيات للأمهات الحوامل والمرضعات لتجنب التقزم لدى الأطفال. شملت العناوين: "متطلبات الطاقة والمغذيات الكبرى خلال الحمل"، و"متطلبات الطاقة والمغذيات الكبرى خلال الرضاعة الطبيعية الحصرية"، و"متطلبات الفيتامينات خلال الحمل والرضاعة الطبيعية الحصرية"، و"متطلبات المعادن خلال الحمل والرضاعة الطبيعية الحصرية". تراوح طول كل فيديو بين ثلاث وخمس دقائق. وكان متوسط درجات الملاءمة ± الانحراف المعياري لمواد التثقيف للفيديوهات 1، 2، 3، و4 هي 94 ± 6.6، 97 ± 7.4، 98 ± 3.7، و99 ± 3.1، على التوالي. وتم تصنيف الفيديوهات التعليمية المطورة على أنها "وسائط متفوقة" بناءً على تصنيفات SAM. أما بالنسبة لمستوى الفهم، فقد بلغ متوسط نسبة الفهم للفيديوهات 1، 2، 3، و4 حوالي 96%، 98%، 99%، و100% على التوالي، في حين بلغ متوسط نسبة القابلية للتنفيذ 95%، 99%، 99%، و99% على التوالي. وفي الختام، أظهرت الدراسة أنّ الفيديوهات التعليمية المطورة كانت ذات مستوى جيد من حيث الملاءمة، والفهم، والقابلية للتنفيذ. ويمكن لهذه الفيديوهات

أن تكون أدوات قيمة لتثقيف الأمهات الحوامل والمرضعات حول احتياجاتهن الغذائية للوقاية من التقزم لدى الأطفال. ويمكن للبحوث المستقبلية أن تستكشف تأثير هذه الفيديوهات على الممارسات الغذائية الفعلية والنتائج الصحية في الفئات المستهدفة.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Health Science (Health Promotion).

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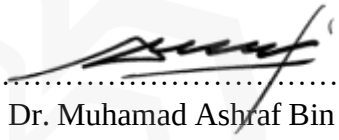

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……

Prof. Dr. Ahmad Aidil Arafat Bin Dzulkarnain
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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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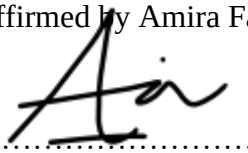

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ACKNOWLEDGEMENTS

All glory is due to Allah, the Almighty, whose Grace and Mercies have been with me throughout the duration of my programme. Although it has been tasking, His Mercies and Blessings on me ease the herculean task of completing this thesis.

I am most indebted to my supervisor, Assoc. Prof. Dr Nor Azwani Mohd Shukri, whose enduring disposition, kindness, promptitude, thoroughness and friendship have facilitated the successful completion of my work. I put on record and appreciate her detailed comments, useful suggestions and inspiring queries, which have considerably improved this thesis. Her brilliant grasp of the aim and content of this work led to her insightful comments, suggestions and queries, which helped me a great deal. Despite her commitments, she took time to listen and attend to me whenever requested. The moral support she extended to me is no doubt a boost that helped in building and writing the draft of this research work. I am also grateful to my co-supervisor, Asst. Prof. Dr. Muhamad Ashraf Rostam, whose support and cooperation contributed to the outcome of this work.

Lastly, my gratitude goes to my beloved parents and friends for their prayers, understanding and endurance while away.

Once again, we glorify Allah for His endless mercy on us one of which is enabling us to successfully round off the efforts of writing this thesis. Alhamdulillah.

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LIST OF ABBREVIATIONS

BPKK	Bahagian Pemakanan Kesihatan Keluarga
BMI	Body mass index
DRI	Dietary reference intake
DDR	Design and developmental research
EAR	Estimated average requirement
EFSA	European Food Safety Authority
et al. (et alia)	and others
GI	Glycemic index
GL	Glycemic load
IAAO	Indicator amino acid oxidation
I-CVI	Content validity index of each item
IOM	Institute of Medicine
MOH	Ministry of Health
NCCFN	National Coordinating Committee on Food and Nutrition
RNI	Recommended nutrient intakes
S-CVI	Scale level content validity index
S-CVI / AVE	Averages item-level content validity index
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

In Malaysia, childhood stunting is a significant public health issue despite improvements in overall health indicators. According to recent data, the prevalence of stunting among children under five years old stands at approximately 20% (UNICEF, 2019), highlighting persistent nutritional challenges faced by Malaysian families. Stunting, defined as impaired growth and development due to chronic malnutrition during critical periods such as pregnancy and early childhood, has profound long-term consequences. Children affected by stunting are more likely to experience developmental delays, cognitive impairments, and increased susceptibility to infections, compromising their overall health and future potential (De Sanctis et al., 2021).

Maternal nutrition plays a pivotal role in preventing childhood stunting. Inadequate intake of essential nutrients during pregnancy, such as carbohydrates, protein, fats, vitamins and minerals, can hinder fetal growth and development, contributing to stunting (WHO, 2020). The World Health Organization (WHO) emphasises the importance of promoting diverse diets that meet maternal nutritional requirements during pregnancy and lactation. Ensuring sufficient calorie intake, combined with micronutrient supplementation where necessary, can significantly reduce the risk of stunting and improve maternal and child health outcomes.

To effectively communicate these crucial messages to Malaysian mothers and caregivers, video animation offers a compelling and accessible educational tool Research indicates that animated videos can effectively engage viewers by utilizing colourful visuals, compelling storytelling, and

culturally relevant content. For instance, a study published in the *Journal of Medical Internet Research* highlights that integrating local characters, visuals, and narratives into health education content enhances accessibility and relevance, thereby improving engagement and understanding among target audiences.. By illustrating the importance of maternal nutrition through clear and memorable visuals, animated videos can effectively convey complex information about dietary diversity, micronutrient supplementation, and its impact on child development. This approach not only enhances understanding but also motivates positive behavioural changes, ultimately contributing to efforts to reduce childhood stunting prevalence in Malaysia.

1.2 STATEMENT OF RESEARCH PROBLEM

Child stunting is a critical global health issue. The prevalence of stunting in children under the age of 5 has decreased by 17.9 percentage points, dropping from 40.2% [39.1% - 41.3%] in 1990 to 22.3% [21.8% - 22.9%] in 2022 (WHO, 2024). The causes of childhood stunting are multifactorial, such as low maternal education, below-normal maternal body mass index (BMI) and poor maternal nutrition (Li Z et. Al, 2020). Stunting not only has both short- and long-term effects, but it also has direct and indirect effects on children, such as low birth weight, hindering cognitive development and school achievement, limiting their life prospects into adulthood, and the most worrisome is increasing the rate of mortality (Rahman et al., 2020). It is reported that about 3.1 million global child deaths per annum are due to childhood stunting (Black et al., 2013; United Nations Children's Fund (UNICEF), 2016; Black et al., 2008).

Intervention via nutrition education to increase awareness and knowledge among mothers is vital to curb this issue. A past study on intervention for exclusively breastfeeding mothers by using a booklet reported unsatisfied results on the knowledge of participants (Shabadi, Kulkarni, Kumar, et al., 2020). Thus, other initiatives are needed to approach more people effectively. This aligns with the WHO Global Strategy on Digital

Health 2020-2025, a detailed plan developed by the WHO to promote the global adoption of digital health technologies. It aims to improve health systems, enhance health services, and achieve the Sustainable Development Goals (SDGs) related to health. This strategy is a roadmap for countries and health organisations to integrate digital health into their policies and practices effectively.

However, nutrition education tools, especially in a digital format such as animated video series that may be more conveniently disseminated among the public, are still lacking in our country. As far as we concern, some videos rely on traditional lecture-style delivery, with heavy text or monotonous narration, which may fail to captivate viewers. While some videos use basic visuals, they may lack dynamic elements like animations, relatable storytelling, or culturally appropriate imagery to keep the audience interested. Engagement is crucial for retention and behavior change. Therefore, this study aims to develop a series of animated videos for education on maternal nutrition to prevent further prevalence of childhood stunting in Malaysia.

1.3 RATIONALE OF THE STUDY

Childhood stunting is a pervasive issue worldwide, including in Malaysia, and remains a significant public health concern linked to inadequate maternal nutrition during crucial developmental periods. Despite efforts to improve overall health outcomes, the prevalence of stunting among Malaysian children under five years old highlights ongoing challenges in nutritional management during pregnancy and lactation (Lee WS, 2022). The first 1,000 days of life, starting from conception, represent a crucial window for promoting healthy growth and preventing stunting, as maternal nutrition and exclusive breastfeeding are pivotal (Black et al., 2013). However, barriers such as low maternal awareness, cultural misconceptions, and inadequate access to health information often impede optimal practices (Victora et al., 2016).

The rationale for this study is rooted in the urgent need to educate childbearing women especially pregnant women and mothers who breastfeed exclusively with comprehensive knowledge of optimal nutritional practices in preventing childhood stunting. This is because mothers are often the primary caregivers and decision-makers regarding a child's diet and care. Empowering them with knowledge on nutrition equips them to make informed choices that directly impact their child's growth and health. By utilizing educational animated videos as a medium, the study aimed to leverage visual storytelling to effectively communicate essential information about dietary diversity, nutrient requirements, and the importance of maternal nutrition in preventing stunting. Animated videos offer a dynamic and engaging platform that can transcend literacy barriers, appeal to diverse audiences, and facilitate greater understanding and retention of key health messages.

Innovative approaches are needed to address these challenges and foster behavioural change. Animated videos have emerged as an effective medium for health promotion, leveraging colourful visuals, engaging storytelling, and culturally relevant content to captivate diverse audiences (World Health Organization, 2018). This study aims to develop and evaluate animated videos designed to educate and empower pregnant women on the importance of healthy nutrition during pregnancy and exclusive breastfeeding for stunting prevention. By addressing the specific needs and challenges of the Malaysian population, this research seeks to bridge existing gaps in health communication and contribute to reducing childhood stunting.

Furthermore, the study endeavors to contribute actionable insights and recommendations for health education strategies aimed at reducing childhood stunting in Malaysia, thereby enhancing maternal and child well-being and fostering a healthier future generation.

1.4 RESEARCH QUESTION AND OBJECTIVES OF THE STUDY

1.4.1 Research Questions

1) What is the content of the animated video series on healthy maternal nutrition during pregnancy and breastfeeding for preventing child stunting
2) How can an animated video series on maternal nutrition for child stunting prevention be developed
3) What are the ratings for suitability, understandability, and actionability of the animated video series among the target audience

1.4.2 Research Objectives

General Objective:

To develop and evaluate an animated video series on maternal nutrition during pregnancy and exclusive breastfeeding to prevent childhood stunting.

Specific Objectives:

1) To design video content by conducting a systematic literature review and referencing evidence-based guidelines.
2) To construct and validate storyboards and scripts for the animated video series with input from nutritionists, educators, and multimedia experts.
3) To develop an animated video series using appropriate software tools.
4) To evaluate the suitability, understandability, and actionability of the animated video series among the target population using validated assessment tools.

CHAPTER 2

LITERATURE REVIEW

2.1 CHILDHOOD STUNTING

Stunting is the impaired growth and development of a child up to the age of five due to the impact of chronic malnutrition, repeated infection, and inadequate psychosocial stimulation (WHO, 2015). It is a significant public health concern globally, as it can negatively impact the child's overall well-being, educational attainment, and future productivity (Galasso, 2018).

2.1.1 Definition of Childhood Stunting

To identify stunting in children, recumbent length is used to measure children below two years old and standing height for children aged two years or older (Mercedes De Onis et al. 2016). A child is categorized as stunted if their height falls more than two standard deviations below the WHO Child Growth Standards. This situation often goes unnoticed in the community because short height has ordinarily been considered standard, besides the lack of awareness and routine assessments among the children (Mercedes De Onis *et al.,* 2016). Therefore, in 2012, the World Health Assembly Resolution 65.6 aimed to reduce 40% of stunted children by increasing the strategies, investment, and action for interventions and policies (WHO, 2012).

2.1.2 Prevalence of childhood stunting

As reported by the United Nations Children's Fund, UNICEF (2019), in 2016, 20.7% of children under five years old in Malaysia suffer from

stunting. In 2016, the most prevalent cases of stunting were recorded in the East Coast region of Peninsular Malaysia, with 34% in Kelantan, 26.1% in Terengganu, and 25.7% in Pahang (Haron et al., 2023). These areas known for their high rural populations and economic disparities, which may contribute to malnutrition (Haron et al., 2023). From 2012 until 2022, the prevalence of stunted children under five has increased rapidly over ten years, from only 17.6% to 21.9%, respectively (UNICEF, 2023).

Globally, the prevalence of stunting decreased from 40% in 1990 to 25% in 2013, as reported by Mercedes et al. (2016), highlighting a divergence from Malaysia's rising trend. This data involved 161 million five- year-old children, half of whom were living in Asia, which includes Malaysia. This statistic showed that the number of children worldwide who are stunted is decreasing from year to year, except in Malaysia. According to research, globally, in 2019, approximately 144 million children under the age of five were stunted, with the highest burden observed in sub-Saharan Africa and South Asia (Vaivada et al., 2020). In Southeast Asia, while progress has been made in recent years, stunting rates remain significant, affecting around 27% of children under five in the region.

In short, strategies for preventing stunting must be outlined immediately to decrease the prevalence of stunting among children, which later might cause unwanted consequences to the children and our future country's development.

2.1.3 Consequences of Childhood Stunting

Most of the health issues related to children have consequences either in the long term or the short term, especially for those categorised as stunted. Mustakim et al. (2022) reported that stunted children have numerous functional drawbacks that may last throughout their lifetime. First and

foremost, enormous and rising evidence shows that a lack of nutrition of the mothers can affect children's cognitive growth. During 24 to 42 weeks of gestation, insufficient nutrition can affect the development of the brain (De Sanctiset al., 2021). The study further explained that the early years of childhood witness a rapid progression in the structural and functional aspects of the brain, which is crucial for acquiring cognitive, language, and socioemotional skills. Then, this developmental process continues into later years for many skills (De Sanctis et al., 2021). Notably, undernutrition has a detrimental impact on specific areas of the brain that play a role in cognition, memory, and motor skills.

The initial stages of childhood involve substantial energy demands for the brain, and most cerebral growth occurs within the first two years of life. However, the precise connections between inadequate linear growth and compromised neurodevelopment remain inadequately understood. Nutritional stunting, a consequence of undernutrition, is believed to be linked to both structural and functional abnormalities in the brain, contributing to a wide array of cognitive deficits (De Sanctis et al., 2021).

Chronic malnutrition can affect central nervous system which result in tissue damage, disorganised differentiation, decreased synapses and synaptic neurotransmitters, delayed myelination, and an overall reduction in the development of dendritic arborisation in the evolving brain. This disruption in the chronological sequences of brain maturation further interferes with the formation of neuronal circuits. Long-term consequences manifest as enduring alterations in brain function, potentially giving rise to sustained cognitive impairments associated with malnutrition (De Sanctis et al., 2021).

Mustakim et al. (2022) further clarified that a lack of cognitive development could decrease the country's future economic productivity. However, the mechanism may differ according to insufficient nutrients, or

many variables could act differently. In the long term, stunted children have been found to have lower earnings. For example, a study in Brazil proved that an increase of 1% in height was associated with an increase of 2.4% in wages (Dewey & Begum, 2011), where both taller men and women earned more even after controlling for education, BMI, per capita energy intake and per capita protein intake. Although the magnitude of the relationship between stunted and poor economic status has generally been small, decreasing stunting caused a 10% rise in Gross Domestic Product (GDP) per capita (McGovern, Krishna, Aguayo, & Subramanian, 2017).

To sum up, it is critical to prevent stunting by giving adequate nutrition early during pregnancy and until two years old. The consequences of childhood stunting are not only in terms of reduced height but also include cognitive development including lower IQ, reduced academic performance, and poorer problem-solving abilities and may affect the future well-being of the children. For instance, a study by Grantham-McGregor et al. (2007) found that stunted children scored significantly lower on cognitive and educational tests compared to their non-stunted peers. The research indicated that children who experienced chronic undernutrition in their early years exhibited delayed language development, impaired memory retention, and reduced executive functioning skills, which ultimately affected their future educational and employment opportunities (Grantham-McGregor et al., 2007). The economic burden from reduced productivity and increased healthcare costs is further due to childhood stunting. Therefore, efforts must be made on a wide scale to implement comprehensive interventions, emphasising nutrition, healthcare, and socio-economic factors to break the cycle of stunting and promote a healthier future for generations to come.

2.1.4 Determinants of Childhood Stunting

The first thousand days after conception are vital to child development and

avert child stunting. The leading causes are household socioeconomic status and parental nutrition (Li et al., 2020), where maternal undernutrition contributed to 20% of child stunting (Özaltin, 2010). The less common causes of childhood stunting are environmental needs, health behaviours, illness prevalence, maternal reproductive situation (Li et al., 2020), and micronutrient deficiency (Black et al., 2008).

As determined by Widyaningsih et al. (2022), socioeconomic status was referred to as household expenditure and categorised into four quartiles. The first quartile represented the poorest group, classified as a single category, while the remaining three quartiles were grouped as wealthier categories.. The study further proved that the prevalence of stunting was higher in poor households compared to non-poor households. This is due to the consumption of unhealthy snacks in poor families being higher than in non-poor families, which leads to childhood stunting (Widyaningsih et al., 2022). In addition, poor households that live in rural areas also have a higher prevalence of stunting because of a lack of access to health facilities, poor exposure to maternal education and poor hygiene (Widyaningsih et al., 2022).

Besides, women's nutrition is essential in optimising gestation outcomes, affecting maternal, foetus, and child health developments (Morrison, 2016). According to the WHO (2014), inadequate nutrition is a condition when a person is eating inadequately or eating food that lacks important nutrients that can contribute to self-growth. As reported by Santosa et al. (2022), mothers who consume less milk, vitamins and folic acid during pregnancy have a higher opportunity of having a stunted child compared to mothers with enough nutrition due to a lack of knowledge in maternal nutrition. Maternal nutritional knowledge is crucial in the growth of healthy children in preventing child stunting. Thus, ensuring proper nutrition by giving adequate knowledge, especially for pregnant mothers, is crucial during the first thousand days after conception. Maternal well-being

and adequate nutrition not only contribute significantly to the health of the child but also lay the foundation for their long-term development and overall quality of life.

2.2 MATERNAL NUTRITION DURING PREGNANCY AND EXCLUSIVELY BREASTFEEDING

2.2.1 Total Energy Requirement

A complete and healthy diet consists of adequate energy, protein, vitamins, and minerals through various foods (WHO, 2020). An adequate nutrient intake is essential during pregnancy, not only for foetal growth but also for breast milk production. The total energy intake for pregnant women is slightly higher than that of their nonpregnant counterparts. According to the Recommended Nutrient Intakes for

Malaysia, RNI (National Coordinating Committee on Food and Nutrition (NCCFN), 2017), energy requirements for nonpregnant women vary according to their age and physical activities, as seen in Table 2.1.

Table 2.1 Energy requirement for female adults and elderly in kcal/day according to the RNI (NCCFN, 2017).

	Low active	**Moderately active**	**Active**	**Very active**
Age Range/PAL	**(1.4)**	**(1.6)**	**(1.8)**	**(2.0)**
19 - 29 years old	1610	1840	2080	2310
30 – 59 years old	1660	1900	2130	2370

**PAL: Physical activity level*

During pregnancy, it is normal for the pregnant mother to gain weight according to their current BMI. Mothers need 13% and 25% higher energy requirements during pregnancy and lactation, respectively, compared to nonpregnant and non-lactating women. According to the Nutrition Division (Ministry of Health (MOH), 2022), pregnant mothers need 2,000–2,470 kcal

per day for healthy foetal growth, while lactating mothers need 2,500 kcal per day. Therefore, pregnant mothers must monitor their intake and body weight to avoid complications (Most et al., 2019).

In addition, according to the RNI (National Coordinating Committee on Food and Nutrition (NCCFN), 2017) and Perinatal Care Manual (MOH, 2022), each trimester of pregnancy requires different energy intake to maintain the foetus's healthy growth, especially in avoiding future child stunting. Both guidelines advised adding 80 kcal, 280 kcal, and 470 kcal during the first, second, and third trimesters. Kominiarek et al. (2016) revealed that a full-term pregnancy needs around 80,000 kcal of energy to support the growth of a healthy foetus. Therefore, calorie intake should increase by approximately 300 kcal/day during pregnancy. However, energy requirement varies significantly among women depending on their age, BMI, and activity level. Above all, guidelines recommended increasing energy requirements throughout the pregnancy were crucial in the healthy growth of the foetus.

After delivery, total energy intake is also high compared to nonpregnant and pregnant mothers due to the increased needs for nutrition for recovery, milk production and prevention of maternal malnutrition (Fikawati et al., 2014). To enable exclusive breastfeeding for the first six months after delivery, additional energy intake is required for the production of high-quality milk. On the other hand, malnourished mothers will produce low-quality milk, which later will cause growth problems in infants in terms of neuropsychological and cognitive development (Fikawati et al., 2014). Low quality milk refers to milk that lack essential nutrients required for the optimal growth and development of the infants in terms of deficiency in micronutrients (Krebs et al, 2011) and reduced volume of milk production (Victora et al, 2016). To achieve adequate energy intake during lactation, RNI suggests taking an additional 450 kcal, and the Perinatal Care Manual advises adding 500 kcal from a daily intake of 1,600 kcal to 1,800 kcal per day. Mothers will face the risk of complications if their daily energy intake

is insufficient.

To conclude, recognising and meeting the total energy requirements during pregnancy and breastfeeding were critical steps in the prevention of childhood stunting. Adequate energy intake during these critical periods is not only important for mothers but significantly impacts the growth and development of the infant. A comprehensive approach which includes nutrition education, access to nutrient rich diets and support for maternal health must be prioritised. Taking adequate total energy during pregnancy and lactation might have the potential to break the cycle of stunting and securing a brighter future for children worldwide.

2.2.2 Macronutrients Requirement

The three main macronutrients needed during pregnancy are carbohydrates, protein,and fatty acids (Mousa et al., 2019). Each of the macronutrients plays a vital role in decreasing the prevalence of child stunting.

Carbohydrates are crucial for maternal nutrition since they are the main energy source for pregnant women and lactating mothers to avoid fatigue and foetus malnutrition (NCCFN, 2017). Plant-based carbohydrates consist of soluble fibre (fruits and vegetables), insoluble fibre (nuts and wholegrain) and resistant starch (cooked potatoes and rice) (Mousa *et al.,* 2019). Diets rich in fibre, coupled with a low glycemic index and glycemic load, have the potential to support regular bowel movements, lower blood cholesterol levels, and regulate blood glucose (Mousa et al., 2019). Consequently, incorporating such dietary habits may prove advantageous during pregnancy.

During pregnancy, carbohydrate intake should achieve 50% to 65% of the total energy requirement daily (MOH, 2022), which consists of six to

nine servings of whole grains. Meanwhile, after delivery, mothers are advised to consume an extra 500 kcal to support breastfeeding because lactation causes nutrient loss in mothers through colostrum and breastmilk. Nutrients in milk come from the diet of the mothers, thus, to maintain balance and avoid malnutrition after delivery, an adequate amount of carbohydrates was crucial to be taken. Foods that contain carbohydrates are rice, noodles, spaghetti, fruits, and bread, and they can be easily obtained in Malaysia.

Protein is the second macronutrient that needs to be focused on during pregnancy and lactation. Adequate protein intake is essential as it involves structural and functional biological roles. Nonpregnant women need only 0.8g/kg body weight to 1.0g/kg body weight daily (NCCFN, 2017), while pregnant mothers need 62.5 g of protein throughout the pregnancy. On the other hand, Bahagian Pemakanan dan Kesihatan Keluarga (BPKK) suggests adding 0.5 g, 8 g, and 25 g of protein during the first, second, and third trimesters, respectively, to achieve the daily protein requirement (MOH, 2022). Kominiarek et al. (2016) stated that an intake of 60g or 1.1g/kg body weight of protein daily is considered adequate for pregnant women to avoid anaemic pregnancy.

Meanwhile, The Institute of Medicine (IOM) utilised a factorial approach to determine the requirement of protein in pregnant mothers by considering factors such as protein deposition and the additional amount required to support healthy weight gain (Murphy, 2021). They conclude that protein demand is minimal in the first trimester of pregnancy, at only around 1g/day, with the estimated average requirement (EAR) aligning with the non-pregnant females' value of 0.66 g/kg body weight daily (Murphy, 2021). Then, later, during the second and third trimesters, an increase of 21g/day in protein is needed, resulting in an EAR of 0.88 g/kg body weight/day. Assuming a standard body weight, daily protein intake from calculating EAR can be 38g in the first trimester and 59g in the latter two trimesters

(Murphy, 2021).

In addition, the recommended dietary allowance for protein during the first trimester is set at 46g/day from 0.8g/kg body weight daily and increases to 71g/day (1.1 g/kg/body weight/day) in the second and third trimesters (IOM, 2005). Outside North America, protein requirements established through the factorial method are comparable to IOM recommendations. The European Food Safety Authority (EFSA) determined additional protein needs of 1, 9, and 28 g/day for each trimester, respectively. The nutrition societies of Germany, Austria, and Switzerland (the DACH region), established protein requirements at 0.8, 0.9, and 1.0 g/kg body weight/day during the first, second, and third trimesters (Murphy, 2021). Generally, all guidelines recommend an increased protein intake during pregnancy compared to nonpregnant women. Not only that, after delivery and exclusive breastfeeding, an additional amount of protein is also needed to support the production of milk and prevention of maternal malnutrition, which later can affect the development of the infants.

During lactation, mothers require an adequate amount of protein to maintain their muscle mass as well as providing sufficient nutrients to infants through breastmilk. The current Dietary Reference Intake (DRI) for protein suggests consuming an EAR of 1.05 g protein/kg body weight daily for exclusively breastfed mothers. However, this recommendation is based on factorial calculations rather than direct experiments (Rasmussen et al., 2020). Therefore, to determine the protein requirement for lactating mothers, Rasmussen et al. (2020) conducted a study by using the indicator amino acid oxidation (IAAO) technique. As reported based on their findings, the protein requirement for exclusively breastfeeding women (3–6 months postpartum) is estimated from 1.7 g/kg/body weight to 1.9 g/kg body weight daily, which is quite higher than the DRI of protein suggestion. Compared to the RNI, lactating mothers are recommended to take an additional 19 g/day during the exclusive breastfeeding period in the first six months after childbirth. For reference, nonpregnant women should be taking

about 52g to 53g of protein daily (NCCFN, 2017).

The next important macronutrient for pregnant mothers is fat. There are three types of fats: saturated fat, unsaturated fat, and trans-fat. Good fat consists of monounsaturated and polyunsaturated fats, such as nuts, vegetable oil, olive oil, peanut butter, and fatty fish. On the other hand, saturated fat intake, such as cheese and fatty meat, should be limited, while trans-fatty acids, such as processed food and pastry, should be avoided because they contain unhealthy fats. Taking adequate macronutrients daily is crucial for pregnant and lactating women and the growth of their infants.

The BPKK suggests taking 25% to 30% of fat for pregnant women, consisting of less than 10% saturated fats and 12% to 15% monounsaturated fats (MOH, 2022). Furthermore, the RNI suggests taking different fat content values for each trimester, which are 54 g to 65 g/day during the first trimester, 60 g to 71 g/day for the second trimester, and 65 g to 78 g/day in the last trimester, but still in the similar suggested range of 25% to 30% of the total energy requirement (NCCFN, 2017). In addition, total fat intake during pregnancy should comprise 20-35% of daily calories, similar to nonpregnant women (Kominiarek, 2016).

After delivery, mothers are recommended to take a higher amount of fat, which is 66 g to 79 g/day, to achieve sufficient fat intake during lactation in the first six months (NCPPN, 2017). As reported by Nagel (2021), there was a relationship between maternal dietary components during lactation and infant growth at six months of age. The results reveal that a higher intake of total dietary fat and saturated fat was associated with an increase in the percentage of body fat in the infant at six months old, which showed positive growth development. Based on the Health Start Study, Shapiro et al. (2017) discovered that a maternal diet high in fat referred to more than 30% of total calories and at least 12% of calories from saturated fat was independently linked to the percentage of body fat and fat mass in infants. On the contrary, Bravi et al. (2016) undertook a systematic review to investigate the impact

of maternal diet on the composition of human milk. They specifically focused on studies that directly measured these associations in healthy mothers with full-term infants. Unfortunately, the researchers were unable to find concrete evidence supporting a link between maternal diet and human milk composition where limitation in availability of the relevant studies in their inclusion criteria posed a challenge. Numerous studies have examined the relationship between maternal diet and human milk composition, yet establishing a definitive link remains challenging due to several factors, such as limited quantitative data, methodological variability and lack of standardization. In terms of limited quantitative data, many studies do not provide quantitative analyses of maternal dietary intake and corresponding nutrient levels in breast milk, making it difficult to assess direct correlations (Bravi, 2016). Besides, in terms of methodological variability, where differences in study designs, dietary assessment methods, milk sampling techniques, and analytical procedures lead to inconsistencies across studies, complicating the comparison and synthesis of findings (Petersohn et al., 2024). In addition, the absence of standardized protocols for dietary assessments and milk analysis hinders the ability to draw conclusive comparisons across studies (Adhikari et al., 2022). Due to these limitations, current evidence on the influence of maternal diet on breast milk composition is inconclusive. Further well-designed studies with standardized methodologies are needed to clarify this relationship.

To conclude, understanding the macronutrient requirements, including carbohydrates, proteins and fats during pregnancy and exclusive breastfeeding, was essential for ensuring the health and development of both the mothers and the infants. Each of these macronutrients plays a significant role in supporting the variety of needs during all stages, starting from the early pregnancy journey until childbirth and the production of breastmilk that is rich in nutrients. A well-balanced diet consisting of adequate macronutrient intake is crucial for preventing nutritional deficiency and supporting optimal maternal and infant outcomes.

2.2.3 Micronutrients Requirement

Micronutrients are also crucial during pregnancy to overcome stunting problems (Dewey, 2016). Besides macronutrients, the requirement for micronutrients also increases during pregnancy. Micronutrients consist of a group of vitamins and minerals. There are 14 vitamins altogether, and they are divided into fat-soluble and water-soluble vitamins and fourteen types of minerals that are needed by our body to survive. It is only needed in small quantities in our daily diet. However, it plays a big role in ensuring the health of pregnant and lactating mothers and the baby's development in the womb and after birth.

Vitamin A is categorised as a fat-soluble vitamin and is critical for healthy vision. It also helps the growth of the foetus and accelerates the healing of wounds on the skin, especially after the mother gives birth. Lindsay et al. (2015) reported that supplementing pregnant mothers with vitamin A can reduce maternal mortality by 40%. During pregnancy, both mother and foetus require unique nutrition for their well-being, specifically when there is an elevated demand for vitamin A, with a notable increase observed during the third trimester (Bastos Maia et al., 2019). Pregnancy entails unique nutritional requirements essential for the well-being of both the mother and the developing foetus. Specifically, there is an elevated demand for vitamin A, with a notable increase observed during the third trimester. This heightened need for vitamin A during this phase is attributed to the accelerated foetal development that occurs during the later stages of pregnancy (Bastos Maia et al., 2019). Meeting these nutritional demands is crucial for supporting the overall health and development of both the expectant mother and the growing foetus.

It is crucial to take adequate amounts of vitamin A during pregnancy and exclusively breastfeeding to avoid complications (Maia et al., 2019). Insufficient vitamin A may lead to adverse effects on offspring during

embryonic and postnatal periods, especially at the moment of the formation of the primitive heart and circulatory system. During this critical time, vitamin A deficiency results in severe abnormalities, where the main target include the heart, the central nervous system and its derived structures, the circulatory, urogenital, and respiratory systems, the skull, skeleton, and limbs (Maia et al., 2019). Besides, maternal vitamin A deficiency can also be the main cause of foetal growth failure (~~Bastos~~ Maia et al., 2019). However, mothers need to be careful not to take vitamin A excessively because it is feared that it will have effects such as toxicity to the liver and defects in the baby.

Pregnant mothers need 800 mcg of vitamin A, while after giving birth, mothers need an additional 50 mcg of vitamin A (NCCFN, 2017). The body cannot synthesise vitamin A, and it must be obtained through diet. Preformed vitamin A (retinol and retinyl ester) can be found in animal origins such as dairy products (milk, yoghurt, cheese), liver, fish oils, and human milk and provitamin A (carotenoids) from vegetable sources (fruits, leaves, tubers) (Bastos Maia et al., 2019). The table below shows vitamin A content in foods.

Table 2.2 Vitamin A content in foods (NCCFN, 2017).

Food categories	**Vitamin A (mcg RE/ 100g)**
Chicken liver	16,000
Ox/ beef liver	9,000
Hen egg, whole	304
Duck egg, whole	208
Duck, thigh	69
Chicken, thigh	50
Mackerel, Indian (*Kembong*)	8
Mackerel, Spanish (*Tenggiri*)	8
Mango	214
Papaya	193

Watermelon	68
Red capsicum	1510
*Kesum (*laksa leaf*)*	1210
Maman	960
Carrot	835
Tomato	700
Cornflakes	812
malted milk powder	767
Full cream milk powder	400
Butter	200
Cheddar cheese	117
Sweet potatoes	709

In addition, vitamin B is also essential for pregnant mothers. Adequate intake of vitamin B can prevent foetal defects and muscle spasms in mothers. B vitamins can be found in liver, lean meat, fish, and milk. The following are the vitamin B requirements for pregnant and breastfeeding mothers:

Table 2.3: Vitamin B requirements for pregnant and breastfeeding mothers (MOH, 2019)

Vitamin	Pregnant	Breastfeeding
Thiamin, B1 (mg)	1.4	1.5
Riboflavin, B2 (mg)	1.4	1.6
Pantothenic acid, B5 (mg)	100	100
Pyridoxine, B6 (mg)	18	17
Folic acid, B9 (mcg)	600	500

Folic acid is a type of vitamin B9 needed by pregnant and breastfeeding mothers. Pregnant mothers need 600 ug of folic acid daily, while

breastfeeding mothers in the first six months need only 500 ug daily (NCCFN, 2017). Meanwhile, Jouanne (2021) suggested taking only 400 ug of folic acid during pregnancy and avoiding taking it excessively (>1000 ug/day) to avoid the risk of cancer and impaired foetal development. It is crucial to prevent the baby's defects, such as neural tube defects, and help the production of new cells every day. Foods rich in folic acid sources are green leafy vegetables, legumes, and foods fortified with folic acid.

Vitamin C is also critical during pregnancy and breastfeeding. Vitamin C helps protect body cells by forming collagen production in bones, muscles, skin, and blood vessels. Not only that, but vitamin C is also important in treating wounds, especially after giving birth. The requirement for vitamin C during pregnancy is 80 mg, while the requirement during six months of exclusive breastfeeding is 95 mg (NCCPN 2017). Food sources that are easily available and contain high levels of vitamin C, such as guava, lemon, and papaya, should be taken by mothers who have just given birth to avoid slow-healing wounds.

However, Rumbold et al. (2015) showed data that do not support the statement of vitamin C supplementation, either on its own or in conjunction with other supplements to prevent neonatal death, poor foetal growth, preterm birth, or pre- eclampsia. Thus, further research must be carried out to understand the impact of vitamin C towards placental abruption. Moreover, there was no adequate evidence to support any significant advantages or disadvantages associated with vitamin C supplementation, either administered alone or in combination with other supplements.

Taking vitamin D can help maintain calcium and phosphorus levels in the mother's body. This is important to maintain optimal bone and teeth strength. Administering vitamin D supplements to lactating mothers decreases instances of both vitamin D insufficiency and deficiency. However, Tan et al. (2020) explained that there was a lack of evidence to associate the impact of maternal vitamin D supplementation on bone health.

Pregnant and breastfeeding mothers should receive 15 ug of vitamin D per day (NCCPN, 2017). In the opinion of Hollis et al. (2004), the daily recommended intake of 400 IU/d (10 ug/d) of vitamin D during lactation had been established. This recommendation is crucial not only for maintaining the nutritional vitamin D status of both mothers and infants but also for individuals with darker skin pigmentation. With low exposure to the sun, an intake of 10ug/day is insufficient to maintain adequate circulating 25 (OH)D concentrations, thus providing only minimal amounts of vitamin D to nursing infants through breastmilk. To implement this inadequacy, a maternal intake of 2000 IU/d of vitamin D could increase 25(OH)D concentration for both mothers and infants (Hollis et al., 2004). However, this improvement was limited, especially concerning nursing infants. Therefore, for more substantial progress in enhancing the nutritional vitamin D, a maternal intake of 4000 IU/d is recommended. As determined by Hollis et al. (2004), this higher level has the potential to make significant action in addressing vitamin D deficiencies in both mothers and their infants during the lactation period.

Vitamin D is a fat-soluble vitamin needed by our body. Food sources rich in vitamin D are sardines, eggs, meat, and mackerel. Exposure to the sun also helps mothers get enough vitamin D every day. Table 2.5 below shows vitamin D content in food.

Table 2.5 Vitamin D content of food (NCCFN, 2017; USDA, 2016)

Food	**Vitamin D ug/100g**
Fish, salmon, pink	10.9
Fish, mackerel, cooked	7.3
Fish, sardine, cooked	4.8
Egg, whole	2.0

Milk, cow-fortified, low fat	1.3
Yoghurt, fortified, low fat	1.2
Cheese, cheddar	1.0
Mushroom, oyster	0.7
Potatoes, mashed	0.3

To conclude, the importance of vitamins A, B, C, and D for pregnant and lactating mothers cannot be denied, as these nutrients play important roles in supporting the maternal health of both the mother and the developing child. Ensuring an adequate intake of these vitamins through a balanced and nutritious diet, as recommended, is fundamental for the health and development of infants. Regular nutrition education targeting mothers is crucial to acknowledge the correct requirements and recommendations of maternal nutrition.

Besides vitamins, adequate mineral intake is also important for both pregnant and lactating mothers. Minerals are micronutrients that are needed by the human body in small quantities but can have a big impact on human health. Generally, mineral requirements increase during pregnancy and exclusive breastfeeding due to physiological changes in the mother (Khayat et al., 2017). Therefore, it is crucial to ensure pregnant mothers receive enough nutrients throughout their pregnancy and exclusive breastfeeding. Micronutrient deficiency through fertilisation and pregnancy can lead to anaemia, pregnancy-induced hypertension and pre-eclampsia, foetal growth restriction, increased labour complications, and maternal and foetal mortality (Khayat et al., 2017).

One of the minerals that is needed during pregnancy and lactation is iron. During the first trimester, the iron requirement is quite low due to the absence of menstruation and shows a notable increase in need starting the second trimester to cover the expansion of red blood cells and the transfer of increasing amounts of iron to both the growing foetus and the placental structures (Thomas et al., 2000). As mentioned by Thomas et al. (2000),

further loss of maternal blood during delivery increases the need for iron in mothers and requires higher iron compared to pregnant mothers. In contrast, recent research reported that pregnant mothers need 30-60 mg of iron to avoid anaemia, preterm birth, and low birth weight, while breastfeeding mothers need only 20-29 mg to replace the blood lost after giving birth (NCCFN, 2017, Jouanne, 2021). According to the study, it is advisable to take iron in the early stage and build up iron stores so that higher intake recommendations can distributed throughout the pregnancy (Jouanne, 2021). However, iron requirements during pregnancy and lactation are higher compared to non-pregnant women. Iron can be found naturally in many foods like liver, lean meats, egg yolks, legumes (such as chickpeas and peas), and dried fruits (raisins and dates), as well as iron-fortified foods (iron-fortified bread and breakfast cereals).

Another mineral required during pregnancy and after delivery is calcium. Calcium plays a crucial role in the mineralisation of the foetal skeleton, particularly in the third trimester of pregnancy. During this period, a full-term baby's skeleton accumulates around 30 grams of calcium, with three-quarters of this amount being deposited in the final trimester. To address these heightened calcium needs, the body enhances the absorption of calcium in the intestines early in pregnancy. Furthermore, some cases recommend vitamin D supplementation starting in the seventh month of pregnancy, which contributes to the increased absorption of calcium in the intestines. Inadequate calcium intake can exacerbate the severity of bone loss in the last trimester and elevate the risk of pre-eclampsia. Consequently, maternal calcium requirements significantly rise, especially from the third trimester, with a recommended intake ranging from 1000 to 1200 mg per day (Jouanne, 2021).

In addition, as for calcium requirements, pregnant and lactating mothers need 1000 mg daily to form the baby's bones and teeth, especially in the third trimester (NCCFN, 2017; MOH, 2022). It also helps prevent muscle spasms in pregnant women. This requirement is 200mg higher than

for women who are not pregnant and breastfeeding (NCCFN, 2017). The WHO suggests calcium supplementation solely for populations with low calcium intake to mitigate the risk of pre-eclampsia. It is essential to recognise the critical role of calcium in foetal skeletal developmen particularly during the later stages of pregnancy, and to address maternal nutritional needs to ensure a healthy pregnancy (Jouanne, 2021). Examples of foods high in calcium are milk and dairy products, anchovies, sardines, beans, and green leafy vegetables. Mothers should drink two glasses of milk daily to achieve the calcium requirement.

Iodine intake is also critical for pregnant and lactating mothers to prevent stunting. Pregnant mothers will urinate more often, resulting in the loss of iodine content in the body. To avoid iodine deficiency that can cause hypothyroidism, pregnant and lactating mothers will need as much as 200 ug per day (NCCFN, 2017; MOH, 2022). The WHO's recommendation for iodine intake during pregnancy is 220 to 250 ug/day (Jouanne, 2021). To develop brain tissue in pregnant women and foetuses, the process of thyroid homeostasis was important, which can only be accomplished with an adequate amount of iodine. Moreover, iodine requirements increased by approximately 50% due to maternal thyroid stimulation and iodine transfer to the foetus for the synthesis of foetal thyroid hormones from the second trimester (Jouanne, 2021). This can be found in foods rich in iodine, such as seafood (anchovies, clams, and scallops), iodised salt, milk, and dairy products (cheese and yoghurt). However, experts advised that pregnant mothers should avoid certain fists with a high risk of contamination by parasites, germs or toxins (Jouanne, 2021).

In addition, a diet rich in zinc is also crucial for pregnant and lactating mothers for many biological processes such as cell division, protein synthesis and growth and nucleic acid metabolism. Based on Jouanne (2021), zinc deficiency may lead to various congenital malformations, low birth weight, intrauterine growth retardation and preterm delivery (Jouanne, 2021; Shah, 2006). Pregnant women are required to take a slightly increased

amount of zinc (11mg/day). Meanwhile, the RNI (NCCFN, 2017) suggests intakes of 5.5, 7.0, and 10mg/day during the first, second, and third trimesters, respectively. During the exclusive breastfeeding period, the requirement decreases slowly from 9.5, 8.8, and 7.2mg/day for the first three, six, and twelve months, respectively, after childbirth.

Additionally, pregnant mothers who are taking iron supplements need to be cautious due to research indicating that iron can reduce the absorption of zinc (Elif et al., 2022). It is important to note that this impact is noticeable primarily at elevated concentrations of iron and when both zinc and iron are consumed in a solution form. As a precautionary measure, the study recommends taking iron supplements in between meals. Zinc also plays a positive role in enhancing the absorption of dietary folates, thereby contributing to the prevention of folate deficiencies.

Based on a categorisation of the relation between maternal status or intake of each nutrient and its effect on the nutrient concentration in breast milk, essential nutrients for pregnant and lactating women include vitamins A, B, C, D, iron, calcium, zinc and iodine. In conclusion, not only are the sources of calories, macronutrients, and vitamins important during pregnancy and breastfeeding, but mineral sources also need to be taken sufficiently by diversifying food sources so that the health of the mother and baby is more guaranteed.

2.3 NUTRITION EDUCATION INTERVENTIONS FOR HEALTHY MATERNAL NUTRITION

2.3.1 Knowledge, Attitude and Practices in Maternal Nutrition

Maternal undernutrition is a significant health issues in developing countries because of its association with a burden for both mothers and their children (Nguyen et al., 2017). Nguyen et al. (2017) explained that the intake of iron

and folic acid supplementation showed a significant gap in the knowledge and practice of pregnant mothers, where at least 20% of women in the childbearing period are underweight. This study proves that there is still a high number of people who lack the self- awareness to start healthy practices during pregnancy and breastfeeding. Therefore, the delivery of maternal interventions should be improved to reduce the high burden of maternal and child undernutrition and mortality (Bhutta et al., 2013).

In addition, a study by Nana (2018) showed that although more than half of the participants in the study had good dietary knowledge, only 39.3% of the participants practised good dietary habits, while others still needed to. On the other hand, in 2020, a study was carried out by Shabadi et al. on the effectiveness of educational interventions on breastfeeding among pregnant women. They gave the booklet to the pregnant mother and followed up regarding knowledge, attitude, and practices during the first week of delivery, the third month, and the sixth month of post-delivery. The results showed that only 2.8% knew breastfeeding must begin within one hour after birth, and more than half of the participants did not know the right time to start breastfeeding after delivery. In addition, 22.8% of women knew that exclusive breastfeeding for six months was crucial for child development. This study proved that pregnant and breastfeeding mothers still lack knowledge about healthy nutrition for their children.

In addition, as reported by Fikawati et al. (2014), low dietary energy consumption was due to a lack of knowledge among mothers and attitudes towards high energy consumption during lactation. Based on that study, a significant number of mothers remain uninformed regarding the increase in needs during lactation compared to during pregnancy. This attitude is due to mothers' belief that a higher need for energy during pregnancy facilitates more growth of the foetus compared to milk production after childbirth. Unfortunately, the crucial information has not been effectively spread to the public through health information authorities such as healthcare professionals and media outlets (Fikawati et al., 2014).

This deficiency in delivering effective communication has endangered the knowledge gap within the general population. Knowledge is an important determinant influencing individual attitudes and behaviours, especially in matters of health. In this situation, the absence of comprehensive awareness regarding the increased nutritional demands during lactation may impact maternal dietary choices

and practices. Strategically, raising awareness through health education initiatives and accessible media channels can help dispel this misunderstanding among mothers while promoting the overall wellbeing of both mothers and infants. (Fikawati et al., 2014).

2.3.2 Nutrition Education Tools

Nutrition education involves imparting knowledge about the science of nutrition to individuals or targeted groups (Deshpande, 2003). Health professionals like dietitians, nutritionists, and nurses play an important role in assisting individuals with changes in their eating patterns and behaviour. The primary goal of this nutrition education is not only just conveying knowledge and information, but rather fostering lasting behavioural changes. These components of education are then presented to the target population to absorb and apply the information. Successful nutrition education is about making nutritional insights understandable and applicable in everyday life, ensuring that individuals can effectively practice them in their daily routines. Nutrition knowledge education can be carried out in numerous ways, either through hard copy, such as newspapers, books, pamphlets, and brochures, or softcopy, such as video animation and the online worldwide web.

The Health Belief Model is crucial in the development of nutrition education tools. It is a psychological framework used to understand health-related behaviours by examining individuals' beliefs and perceptions about health threats and the effectiveness of actions to overcome the situation (Coulston et al., 2017). It is believed that people are more likely to

participate in health-promoting behaviours if they are aware of their health problem, believe the problem to be severe, see the benefits of taking action and perceive few barriers to doing so (Coulston et al., 2017). To develop nutrition education, the Health Belief Model can used as a guideline in education tools by ensuring to address the severity of nutrition deficiencies, susceptibility to them, benefits of implementing healthier dietary practices and strategies to overcome barriers such as lack of knowledge or resources. By aligning nutrition education tools with the theory of the Health Belief Model, health educators can tailor interventions to effectively promote healthy lifestyles and improve nutritional outcomes.

2.3.2 Digital Nutrition Education Tools

Digital transformation for delivering health information must be done to achieve effectiveness in health education (WHO, 2021). These worldwide plans aim to maintain digital health technologies aligned with the national health sector and health strategies. It is anticipated that by 2025, a digital health ecosystem will be established in the country, encompassing a variety of digital information technology infrastructure primarily utilised by healthcare providers, health service providers, and patients (WHO, 2021). Public health authorities, universities, and research institutions are also expected to use this infrastructure. Videos and images can attract viewer interest, enhance learning, and reach more people worldwide without boundaries or limitations (Galmarini et al, 2024). In contrast, traditional nutrition education tools (face-to- face counselling, printed booklets, and pamphlets) have limited outreach and can only be targeted at certain places (Moe-Byrne et al, 2022).

Implementation of digital health can bring lots of benefits to childbearing-age women in terms of accessibility, convenience, interactive learning, and educational resources (Ronquillo, 2023). Digital health tools make nutrition education more accessible to a broader audience. Pregnant and lactating mothers can access information at their convenience, reducing

barriers related to location and time constraints. Next, digital tools can provide attractive content, such as a series of animation videos. This enhances the learning experience for pregnant and lactating mothers, making it more understandable and memorable (Ronquillo, 2023). Digital health platforms can serve as repositories for various educational resources, including articles, recipes, and guidelines. This comprehensive approach ensures that mothers have access to a wealth of information to support their nutritional needs. In a nutshell, the incorporation of digital health in nutrition education for pregnant and lactating mothers enhances accessibility, personalisation, and engagement, ultimately contributing to improved maternal and child health outcomes.

2.3.2.1 Using Videos as A Nutrition Education Tool

Nowadays, video education is more practical than other hardcopy tools such as pamphlets, flyers, or newspapers. Video animations were created with original designs, illustrations, or computer-generated effects that had been made to move an eye-catching using any number of artistic styles and did not require any live-action recording to convey an idea or story. In comparison with hardcopy tools, video animations can get more engagement with interactive media and can easily be shared globally through online platforms, making them accessible to a wider audience.

The Cognitive Load Theory enhances educational videos' effectiveness by focusing on the amount of information that working memory can hold at one time and how instructional design can be optimized to facilitate the learning process without overwhelming the learners. According to this theory, instructional materials should be designed to minimise unnecessary cognitive load (extraneous load) and promote the processing of critical information (intrinsic and germane load) (John Sweller et al., 2011). Some significant extra values in educational videos can attract viewers' interest. These include signalling, segmenting, weeding, and matching modalities. Signing, or cueing, uses on-screen text or signs to draw

attention to significant information. This can be achieved through two or three keywords, a change in colour or contrast, or a symbol like an arrow that guides the viewer's gaze to a specific area of the screen. Brame (2016) highlighted the effectiveness of signalling in enhancing information retention. Similarly, de Koning et al. (2009) found that changes in colour or contrast can aid in focusing attention on key information.

By applying the Cognitive Load Theory, video creators can enhance learning by emphasising critical information, which helps the learner's explicit engagement and reduces the extraneous load. In addition, this would also enhance information retention. Mayer and Moreno (2003) and de Koning et al. (2009) have indicated that this approach increases students' capacity to retain and apply new knowledge acquired from animations. Ibrahim et al. (2021) have also demonstrated that this effect applies to videos. This ensures that the target audience not only understands the presented information but is also able to apply it in their daily lives.

To create an impactful video, segmenting information into smaller chunks is important. This segmentation allows learners to engage with new information at their own pace and retain it more effectively. Additionally, it is beneficial to eliminate distracting elements such as music, complex backgrounds, or unnecessary features that might divert the learner's attention. This video animation gives them better control over the flow of information and helps them focus on what is important. In fact, Ab Hamid (2022) revealed that the developed videos on dietary management are highly understandable, actionable, and suitable for use as educational videos.

2.3.2.1.1 Advantages of Using Videos for Nutrition Education

In certain countries, nurses have used educational videos as an effective education and health promotion strategy due to their versatility and applicability (Rodrigues, 2017). In brief, the combination of educational

videos and interventions by healthcare professionals can enhance public understanding of the issues, leading to the early identification and resolution of health problems (Rodrigues, 2017). As explained by Collishaw (2023), students who were exposed to video treatment improved their nutrition knowledge scores compared to those who received traditional classroom instruction. The above studies proved that education can be delivered more conveniently and practically through video to reach more people effectively.

Schneider, Ollila, and Mutanen (2022) conducted a study on twelve community health workers (CHWs) who were given educational videos on nutrition based on the WHO recommendation to support their work during their visits with the families. Three months later, they conducted interviews individually with eight CHWs and sixteen mothers to investigate the effectiveness of the education videos in delivering information. The study revealed that learning from nutrition education videos was easier compared with traditional education and showed improvement in their daily practices. This study showed that educational videos are well-received among CHWs and mothers.

2.3.2.1.2 Advantages of Using Animation for Nutrition Education

In relation to the study by Erika et al. (2023), education using animated videos and leaflets increased the knowledge of mothers who had babies aged 4-5 months to prepare complementary feeding. Their study conducted pre- and post-tests to measure the mother's knowledge about the preparation of complementary feeding for stunting prevention. The results showed a significant difference in the knowledge and attitude of mothers after an animated video intervention on complementary feeding.

Another study on the advantages of using animation in nutrition education was conducted by Smith & Taylor (2021) on the impact of animated nutrition videos on elementary school children's knowledge and

behaviour. The study involves elementary school children ages from seven to eleven years old located in public schools in California, United States. They conduct pre and post-test questionnaires and observation checklists. This study examined how animated videos influenced children's nutritional knowledge and behaviour. The intervention involved short, colourful, and engaging animated videos that explained basic nutritional concepts like food groups, portion sizes, and healthy eating habits. A comparison between pre-test and post-test scores showed significant improvement in children's ability to recall information and make healthier food choices. However, a limitation was that the study relied on self-reported behaviour changes, which could introduce bias. Additionally, the impact of animation might vary across different cultural and socioeconomic backgrounds, suggesting a need for further research to tailor content to diverse populations.

In addition, as reported by Patel & Gomez (2019), also show the effectiveness of using animation as a nutrition education tool among low-literate adults aged from 25 to 50 years old only. The study was conducted in rural villages in India by structured interviews and dietary recall assessments. Data were then collected through community-based participatory research (CBPR) with before-and-after comparisons. This study assessed the effectiveness of animated videos in teaching nutrition to low-literate populations. The animations used simple visuals, storytelling, and culturally relevant examples to educate participants about balanced diets and food safety. Post-intervention assessments showed improved understanding and adoption of healthier dietary practices. A major strength of this study was its community-based approach, which ensured that content was tailored to the participants' needs. However, challenges included technological barriers (such as lack of access to mobile devices) and resistance to changing long-standing food habits. The study suggests that combining animation with face-to-face community discussions could enhance effectiveness.

These studies highlight the effectiveness of animation in nutrition education across different populations. The key advantages include animation makes complex nutritional concepts more accessible and memorable. Besides, it can be tailored to different age groups, literacy levels, and cultural contexts. However, limitations such as self-reported biases, long-term engagement challenges, and accessibility barriers must be addressed in future research. Combining animation with interactive components or community-based discussions could enhance its impact.

2.4 SUMMARY OF LITERATURE REVIEW

Childhood stunting needs to be prevented at an early stage. As proven by numerous studies, various factors lead to childhood stunting, such as inadequate maternal nutrition during pregnancy and exclusive breastfeeding. Macronutrients that need to be taken adequately include carbohydrates, proteins and fats. Some of the vitamins and minerals that are closely related to preventing childhood stunting also need to be consumed sufficiently, such as vitamin A, vitamin B, vitamin C, vitamin D, zinc, iron, and iodine. By referring to the Health Belief model, the development of nutritional education videos to create awareness and spread knowledge can be constructed. Video education has emerged as a promising tool for disseminating nutrition-related information due to its accessibility, scalability, and ability to convey complex concepts effectively.

While acknowledging the existing importance of nutrition during pregnancy and exclusively breastfeeding, the development and validation of animated videos have never been analysed in Malaysia. To fill the existing gap, this study aims to develop and validate an animated video series specifically tailored to promote healthy nutritional management during these critical periods. The research gap lies in the need for a comprehensive investigation into the development process, content validation, and subsequent assessment of the impact of animated video

series. Understanding how animated videos can effectively communicate complex nutritional information, influence behaviour changes, and contribute to improved health outcomes was an area that has not been extensively explored in the existing literature, hence the need for this study.

CHAPTER 3

METHODOLOGY

3.1 STUDY AREA

This study was conducted at the International Islamic University Malaysia (IIUM), Kuantan Campus, Pahang.

3.2 STUDY DESIGN

This study utilised the design and developmental research (DDR) method, which has three stages: i) content analysis, ii) design and development, and iii) evaluation. The DDR method is a systematic approach used in studies to create and test products which combine aspects of both design and research, emphasizing the process of developing video animation while simultaneously contributing to theoretical knowledge (Richey, 2014).

3.3 STUDY PROCEDURES

3.3.1 Phase I: Content Analysis

The first phase for the DDR method was content analysis. This phase aimed to determine the nutrient intakes during pregnancy and exclusive breastfeeding that influence the prevalence of stunted growth in children. This analysis consisted of literature review and local evidence-based guidelines to achieve the first objective of this study.

Part I: Literature Review

A narrative literature review was conducted to find the link between maternal dietary intake and childhood stunting. The following databases were queried to identify related literature: PubMed, Scopus, Science Direct, and Google Scholar. The findings were further refined to obtain only peer-reviewed literature by using search keywords including 'maternal', 'pregnant women', 'pregnancy', 'nurturing', 'gestation', 'reproductive age', 'retard growth', 'low birth weight', 'low height for age', 'stunting', 'pregnancy diet intake', and 'maternal nutrition'. A restriction of date was put on the search where only the years 2000 onwards were included because this timeframe was determined in consideration of the fact that this was the period in which research on information and communication technology adoption in the eHealth environment began to be conducted globally. Articles that were not written in Malay or English were excluded from this study. As this review focused primarily on nutrition information for pregnant and breastfeeding mothers, articles that refer to non-pregnant and non-breastfeeding mothers were automatically excluded. To expand the range of articles available for review, the search criteria were extended to include the relationship between maternal nutrition and the prevention of stunting.

Part II: Review of Evidence-based Practice Guidelines

The process of determining the content of the animated video series also considered currently available practice guidelines for the specific study population. This is to ensure that the content is both relevant and applicable to the intended audience.

Two widely recognised sets of guidelines, the Recommended Nutrient Intakes (RNI) for Malaysia published in 2017 and the

guidelines established by the Bahagian Pembangunan Kesihatan Keluarga (BPKK), Ministry of Health Malaysia, in 2022, served as the main references for the video content. By aligning video content with these guidelines, the study ensured that the recommendations were in line with local nutritional standards.

The recommendations derived from these guidelines cover the dietary requirements for total energy, macronutrients, and micronutrients, offering comprehensive guidance for both pregnant women and exclusively breastfeeding mothers. This approach helps to create content that addresses the nutritional needs of these specific groups.

3.3.2 Phase II: Development and Validation of Animated Video Series

Construction of Storyboards and Scripts

The development of these animated videos was a carefully structured and thought-out process, starting with the development of a storyboard. This storyboard served as a guideline outlining the specific topics and scripts for the videos. This is a crucial step in ensuring that the content of the videos achieves the objectives of this study. For instance, when developing a storyboard and script for an animated video series on promoting maternal nutrition to prevent childhood stunting, applying Constructivist Learning theory can enhance the educational impact of the videos. This theory emphasizes that learners actively construct their own knowledge and understanding based on experiences and interactions with the world.

Besides, Health Belief Model (HBM) was also used as the theoretical foundation for the development of the storyboards and

scripts to achieve the second objectives of this study. The HBM is a widely used framework in health education, emphasizing how individual beliefs about health conditions influence behaviour change (Rosenstock, 1974; Becker, 1974). This model focuses on six core constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy.

In this study, the storyboard and script were designed to address these constructs systematically. For instance, the animated video highlights the risks of childhood stunting and its long-term impacts (perceived susceptibility and severity), while emphasizing the benefits of proper maternal nutrition (perceived benefits). Cues to action were embedded through emotionally engaging storytelling and culturally relevant characters to motivate behaviour change. Additionally, self-efficacy was promoted by showcasing achievable steps for maintaining good nutrition during pregnancy and lactation. The HBM's emphasis on personal beliefs and actionable strategies made it particularly suitable for this project, ensuring that the video content resonates with the target audience and fosters positive nutritional practices (Champion & Skinner, 2008).

To develop an educational video, these steps were critical to achieve the objective of the video. To develop the storyboard, Bloom's taxonomy cognitive level C2 was used to construct the objectives for each video. Level C2 corresponds to comprehension of the meaning of materials to describe, explain, and give examples. For example, for the first video regarding total energy and macronutrient requirements during pregnancy, the learning objective was to describe total energy and macronutrient requirements during pregnancy and discover sources of macronutrients in foods. Then, the contents of the videos can be created based on the objectives.

Throughout the storyboard and script composition, the study kept several key objectives in mind. The content must suit the specific characteristics of the target population. The study also considered the time allocated for each video, ensuring that it aligned with viewers' attention spans and available learning time. Most importantly, the goal was to enhance the knowledge, attitudes, and practices of individuals who would use these videos as an educational resource. Each video would take about three to four minutes.

Validation of Storyboards and Scripts

Study Population

A panel of nutrition and dietetics experts was selected for content analysis of the videos based on their academic qualification and at least two years of work experience in related fields. The exclusion criteria were those who did not possess nutrition or dietetics qualification, or and had less than two years of work experience in related fields.

Sample Size

Six experts were invited to evaluate the scripts and storyboards of the videos. It is recommended for the assessment process to involve a minimum of six but not more than ten specialists (Yusoff, 2019). With at least six experts, the likelihood of reaching a statistically significant level of agreement among the panel increases. This ensures a credible evaluation of the content. Although a larger panel of experts may provide even greater validity but managing and coordinating large groups becomes challenging. Six experts represent a manageable number that can still yield reliable results. Having at least six independent experts also helps to minimize the influence of individual biases or extreme opinions, making the validation process more balanced and objective (Lynn, 1986).

Assessment of Content Validity

The storyboard and video scripts were evaluated by content experts to ensure accuracy and relevance using the Content Validity Index (CVI). The storyboard and script of each video were assessed based on the Content Validity Index for relevancy and clarity.The content was evaluated by experts (N=6) in relevant areas, such as nutritionists, dietitians, and nutrition or dietetics lecturers. It is recommended that the assessment process involves a minimum of six but not more than ten specialists (Yusoff, 2019). The comments and suggestions provided by the experts were used to improve the storyboards and scripts. For the content evaluation purpose, the Educational Content Validation Instrument in Health (Leite et al., 2018) was used. The Objectives domain comprises of purpose, goals, or target and takes up two out of four items (Items 1 and 2) and achieved an I-CVI value of 1, indicating that all experts agreed that the videos meet the proposed theme and suit the teaching-learning process. For items 3 (clarifying doubts on the addressed theme) and 4 (reflecting the theme), they obtained a 5 out of 6.

The panel of experts were required to rate the animated video storyboards and scripts using the Educational Content Validation Instrument in Health (Leite et al., 2018) with a Likert-type scale, scoring 0 = disagree, 1 = partially agree, and 2 = totally agree. This tool is commonly used to validate educational content presented in videos, games, websites, and software. In this study, fourteen items were included, covering three domains: objective, relevance, and structure/presentation. A comment section was provided for each item, providing opportunities for the experts to give comments and suggestions for improvement and clarifying their rating choices.

The CVI of each item (I-CVIs) was first obtained by dividing the number of experts who rated scores 1 or 2 with the total number of experts. The CVI of relevancy can be calculated on both item level

(I-CVIs) and scale level (S-CVI). Items rated as 1 and 2 would be combined and labelled as 'Relevant' while items with value 0 would be labelled as 'Not Relevant'. For the average item level CVIs (S-CVI/Ave) approach, the total of I-CVIs must be divided by the total number of items, and a threshold of 80% agreement is needed to confirm the relevance of the instrument items.

Based on the feedback and suggestions from the content experts, improvement was made to the storyboard and scripts of the video. The revised storyboard and scripts were then sent back to the experts for a second-round review before final approval. The final script was also sent to a language expert to be translated into a subtitle in English.

Development of Videos

Upon completion of the storyboard and scripts, the videos were developed using a selected animation software (Powtoon, London, UK). The Powtoon app was used to cut and arrange footages, add visual effects, transitions, and animations, as well as perform colour correction and audio editing. The videos were enhanced with images and graphics obtained from the Freepik image bank website (Freepik Company, Malaga, Spain). A Malay voice-over was used for video narration and an English subtitle was included.

Technical Quality Evaluation of Videos

Three experts in video production then evaluated the newly developed video iterations. The experts included an information communication technology senior lecturer in multimedia, a dietetics senior lecturer who specialises in digital nutrition education tools development, and a basic health science senior lecturer who has experience in producing informative videos. The experts were provided the opportunity to watch the videos in advance, and an online feedback session was

conducted with all the experts.

The video iterations underwent revisions based on the experts' feedback and suggestions. Once finalised, the videos were uploaded to the YouTube video-sharing platform (Google LLC, California, USA) for evaluation purposes.

3.3.3 Phase III: Evaluation of the Videos among Intended Audiences

Ethical Approval and Participant Consent

The ethical approval for this study was obtained from the IIUM Research Ethics Committee (IREC Reference No.: IIUM/504/14/11/2/IREC 2021-062) (Appendix G). An informed consent statement was attached to the online questionnaire. The respondents were duly informed that by answering the questionnaire, they indicated their agreement with voluntary participation in the study.

The last objective of this study aimed to assess the suitability, actionability and understandability of these animated educational videos among a subgroup of the intended viewers of the videos.

Study Population

The inclusion criteria were Malaysian women of childbearing age (between 18 and 49 years). This age range was chosen to correspond to the definition of women in their reproductive years as outlined by the WHO in 2006. The exclusion criteria were man of all age, and women younger than 18 years and older than 49 years. They had been approached through Whatsapp groups that consisted of International Islamic Universtiy Malaysia (IIUM) students and outsiders that were Malaysian only.

Sample Size

Fifty study participants were conveniently participated in the evaluation of the newly developed animated video series in terms of suitability, actionability, and understandability. There is no recommended sample size for the evaluation of health educational videos but similar research in the past included between 22 and 50 participants (Koss et al, 2018, Brown et. Al, 2017, Kayler et.al, 2019). The sample size ensures adequate representation of the target audience to capture varied perspectives and cultural nuances. Fifty participants were considered sufficient where can provide robust statistical power for usability and effectiveness testing, allowing meaningful analysis of participant feedback and outcomes as well as feasibility in managing data collection and analysis within the scope of the study.

A link to access a set of online questionnaires and animated educational videos was provided to the participants. These questionnaires were designed to gather feedback and insights from the participants, focusing on their perceptions of the videos' suitability, understandability, and actionability. Sociodemographic information about the participants, i.e. age, educational level, marital status and number of children, were also obtained.

Evaluation of Suitability

The Suitability Assessment of Materials (SAM) tool (Doak et al., 1996) was used to assess the suitability in terms of content, literacy demand, graphics, layout, typography, learning stimulation motivation and cultural appropriateness.

The SAM instrument rates materials in six areas: content, literacy demand, graphics, layout and type, learning stimulation

motivation and cultural appropriateness (Doak et al., 1996). All these elements (comprising 15 factors) were used to evaluate the suitability of the video through Google Forms. The factors included purpose, content topic, scope, summary and review, reading level, writing style, sentence construction, vocabulary, learning advancement, front page graphic, type of graphic, relevance of illustration, tables, chart or list, caption used for graphic, subheading typography, layout, interaction, motivation, culture match, cultural image and examples.

For each factor, participants needed to comment and score accordingly: 2- superior, 1- adequate, 0- not suitable, N/A - not applicable. The maximum total possible score is 30 (100 percent). Below is the formula to calculate the per cent score (Doak et al., 1996):

Total SAM score / (maximum score minus N/A) = Percent score %

The ratings for SAM were interpreted as follows: 70-100 percent: superior material, 40-69 percent: adequate material, and 0-39 percent: not suitable material.

Evaluation of Actionability and Understandability

The actionability and understandability of the videos were evaluated using a validated Patient Education Materials Assessment Tools for Audio-Visual (PEMAT-A/V) questionnaire where the questionnaires were prepared in both language which is English and Malay (Saddki et al., 2018). The PEMAT-A/V consists of nineteen items to evaluate understandability and seven items for actionability of the videos. Six main items determine the understandability of the videos include terms of content, word choice and style, numbers, organisation, layout, and design, and the use of visual aids for all the videos.

For this section, the participant will rate 1 for agree, 0 for disagree and NA for not applicable. The per cent point was calculated as follows by using Microsoft Excel Office 2019:

Total points / total possible points x 100% = per cent point (%)

The higher the score, the more understandable the material is. For example, if the score is 90%, meaning that the materials are more understandable than the score of 60%, the same goes for actionability.

Think Aloud Interview

A Think Aloud interview is a qualitative research method used to explore a person's thoughts by asking the participants to verbalise their opinions, feelings and reactions after watching all the videos (Rheinhart et al., 2022). This method was used to obtain a more detailed feedback from the study participants regarding the videos after they have watched it.

Out of the 50 study participants who were involved in the evaluation phase, ten of them volunteered to participate in the Think Aloud interview. There is no definitive guideline on the best sample size for this technique, but a rule of thumb indicates that at least 10 percent of the total sample size would be desirable (Alshammari et al. 2015).

The study participants were instructed to watch the newly developed videos and then answer a few questions from the researcher regarding the videos (refer to Appendix C for the interview questions). They were encouraged to speak freely without interruption. The interview session was recorded. The recorded data were manually transcribed and analysed to identify repetitive themes related to the research objective.

Research flow chart

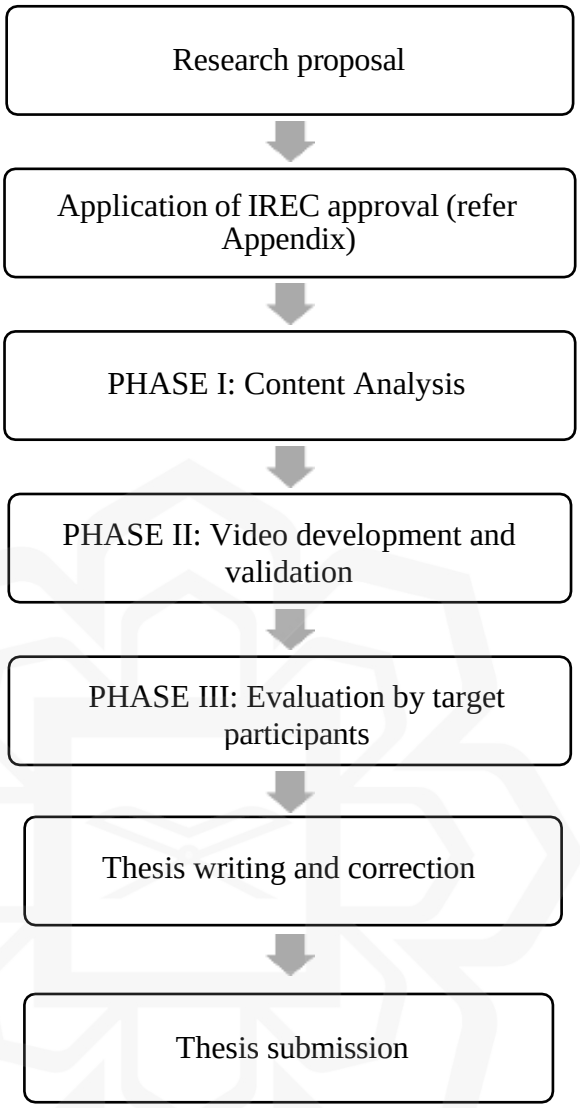

Figure 3.1: General flowchart of the research

CHAPTER 4

RESULTS

4.1 Content Analysis

A systematic literature review was conducted to determine the association between maternal dietary intake and childhood stunting (Mohd Shukri et al., 2023). The findings indicated that pregnant women need to eat a diverse diet with at least five food groups to fulfil the nutritional requirement. In addition, a protein intake between 0.8 and 1.1 g/kg body weight daily is recommended for positive birth weight and height outcomes (Mohd Shukri et al., 2023). Supplementation of vitamin A, vitamin C, iron, zinc, vitamin D and calcium was also shown to improve pregnancy outcomes. Table below show the results for content analysis. Table 4.1 presents a summary of key studies and nutrition guidelines for pregnant and lactating mothers. The table includes 13 guidelines published between 2009 and 2022, providing an overview of relevant recommendations.

Table 4.1: Summary of Key Studies and Nutritional Guidelines for Pregnant and Lactating Mothers

Selected studies / guidelines	**Main component of content**	**Description of the components**
Ministry of Health (MOH), 2022	Caloric intake for pregnant and lactating mothers	Pregnant mothers require 2000 – 2470 kcal/day, while lactating mothers need 2500kcal/day to support fetal growth and milk production

Ministry of Health (MOH), 2022	Carbohydrate intake during pregnancy	**50%-65% of daily energy** should come from carbohydrates, with **6-9 servings of whole grains** to support maternal and fetal energy needs.
Rasmussen et al., 2020	Protein requirements for breastfeeding mothers	Exclusively breastfeeding mothers need **1.05 g/kg body weight** per day, based on factorial estimations rather than direct experimental data.
Kominiarek, 2016	Fat intake during pregnancy and lactation	Fat intake should be **20-35% of daily calories** during pregnancy, increasing to **66-79 g/day postpartum** to support lactation.
NCCFN, 2017; BPKK, 2022	Vitamin and mineral needs for pregnant and lactating mothers	Pregnant and breastfeeding mothers require **vitamins A, B complex, C, D, iron, calcium, and iodine** for fetal growth, immune function, and lactation.
WHO, 2016; Jouanne, 2021	Specific micronutrient intake for pregnancy and lactation	Pregnant mothers: **Vitamin A (770µg), Folate (600mg), Vitamin C (75mg), Vitamin D (5µg)**
Bastos et al., 2019	Role of vitamin A in preventing stunting	Vitamin A deficiency in mothers can impair fetal organ development and immune function, increasing the risk of intrauterine growth retardation and low birth weight. Lactating mothers need 850ug of vitamin A
Keats et al., 2021	Importance of B vitamins for growth outcomes	B vitamin deficiencies are linked to **low birth weight and preterm birth**, which are risk factors for stunting. Supplementation can improve maternal and neonatal health. Lactating mothers need 400mg of folate
Cunningham, 2009	Impact of Vitamin C on birth outcomes	Adequate maternal **Vitamin C levels improve birth weight and immune function**, supporting normal growth and reducing the risk of infections.

Aranow, 2011	Role of Vitamin D in growth and immunity	Vitamin D is essential for **healthy birth weight, bone development, and immune modulation**, reducing risks of stunting and infections
Jouanne, 2017	Mineral requirements during pregnancy and lactation	- Pregnant mothers: **Iron (27mg), Zinc (11mg), Calcium (1000mg), Iodine (220µg)** - Lactating mothers: **Iron (60mg), Zinc (19mg), Calcium (1000mg)**

4.2 Video Design and Development

4.2.1 Storyboard and Scripts Construction

Based on the literature and guideline documents review, the topics covered in the videos were:

i) Total energy and macronutrient requirements for pregnant mothers
ii) Total energy and macronutrient requirements for exclusively breastfeeding mothers
iii) Vitamin requirements for pregnant and exclusively breastfeeding mothers
iv) Mineral requirements for pregnant and exclusively breastfeeding mothers

In designing the video content, this study used Bloom's taxonomy as a reference, drawing from Dettmer's work in 2005. Bloom's taxonomy consists of six levels of education to structure the learning outcomes of education (Adam, 2015). Two essential levels were included in the production of the storyboard of the videos: remembering and applying. This approach helps the target audience to retrieve, recognize and recall relevant knowledge from long-term memory and implement this knowledge in their daily life. Table 4.2 presents the complete storyboard of the videos.

The scripts of the videos were developed based on learning objective and contents from storyboards. Malay was chosen as the language since the target audience was Malaysians who use Malay as their main language. English subtitles were included to enhance understanding of the videos among wider audience.

Table 4.2: Storyboard of the videos.

TOPIC	LEARNING OBJECTIVES (Bloom's Taxonomy Cognitive Level C2)	LEARNING APPROACH	CONTENT
1. Total energy and macronutrient requirements during pregnancy towards prevention of childhood stunting (Duration: 4 minutes)	After watching the video, viewers should be able to: 1. Describe the total energy requirement during pregnancy 2. Describe the macronutrient requirements during pregnancy 3. Discover the sources of macronutrients in foods 4. Indicate the implication of stunting in children	- A brief introduction on definition, prevalence, and risk of stunting in Malaysia - Explanation about the recommended total energy and macronutrient (carbohydrate, protein, and fat) intakes during pregnancy	- A brief objective and outline of content - Definition of stunting according to the WHO - Prevalence of stunting in Malaysia (Graph, with the states with the highest prevalence highlighted) - Implication of childhood stunting - Recommended values of total energy and macronutrients during pregnancy - Images of the foods and portions to be taken for each macronutrient - Examples of food portions that may be consumed to meet increased requirements - Summary of content
2. Total energy and macronutrient requirements during	After watching the video, viewers should be able to: 1. Describe the total energy requirement during breastfeeding	- A brief introduction on prevalence, risk of stunting in Malaysia. - Explanation about the recommended total	- A brief objective and outline of content - Definition of stunting according to the WHO

exclusive breastfeeding towards prevention of childhood stunting (Duration: 4 minutes)	2. Describe the macronutrient requirements during breastfeeding 3. Discover the sources of macronutrients in foods 4. Indicate the risk and implication of stunting	energy & macronutrient (carbohydrate, protein, and fat) intakes during exclusive breastfeeding	- Prevalence of stunting in Malaysia (Graph, with the states with the highest prevalence highlighted) - Implication of childhood stunting - Recommended values of total energy and macronutrients during exclusive breastfeeding - Images of the foods and portions to be taken for each macronutrient - Examples of food portions that may be consumed to meet increased requirements - Summary of content
3. Vitamin requirements during pregnancy and exclusive breastfeeding (Duration: 3 minutes)	After watching the video, viewers should be able to: 1. Describe the function of each vitamin and its deficiency implication 2. Describe the vitamin requirements during pregnancy and exclusive breastfeeding 3. Discover the sources of vitamins in foods	- Explanation about the functions of, recommended intakes, and the sources for, essential vitamins during pregnancy and exclusive breastfeeding. - The list of vitamins includes vitamins A, B1, B2, B6, folic acid, C and D	- A brief objective and outline of content - Description for each vitamin would include: ● Its function and deficiency implication ● Recommended values during pregnancy and exclusive breastfeeding ● Food sources (images) - Summary of content

4. Mineral requirements during pregnancy and exclusive breastfeeding (Duration: 3 minutes)	After watching the video, viewers should be able to: 1. Describe the function of each mineral and its deficiency implication 2. Describe the mineral requirements during pregnancy and exclusive breastfeeding 3. Discover the sources of minerals in foods	- Explanation about the function of, recommended intake, and the sources for, essential minerals during pregnancy and exclusive breastfeeding. - The list of minerals includes calcium and iron.	- A brief objective and outline of content - Description for each vitamin would include: ● Its function and deficiency implication ● Recommended values during pregnancy and exclusive breastfeeding ● Food sources (images) - Summary of content

4.2.2 Storyboard and Script Evaluation

The storyboard and script for each topic were drafted and sent to six experts in nutrition and dietetics for evaluation. The content experts included a dietitian, a nutritionist, and four lecturers from the Department of Nutrition Sciences, KAHS, IIUM.

For the content evaluation purpose, the Educational Content Validation Instrument in Health (Leite et al., 2018) was used. The findings are shown in Table 4.3. In summary, with the S-CVI/Ave value of 0.92, the objectives domain obtained an acceptable relevance among the experts. All seven items in the structure/presentation: organisation, structure, strategy, consistency and sufficiency domain achieved I-CVI values of 1.0, indicating universal experts' agreement. Therefore, the designed contents have interactive language, objective information, and a reasonable sequence of thoughts. Similarly, the domain relevance: significance, impact, motivation and interest also obtained the universal experts' agreement with S-CVI/Ave score of 1.0. All experts agreed that the content in the video scripts encourages learning, contributes to knowledge in the area and arouses interest in the theme.

Table 4.3: Ratings on domain objectives, structure/presentation, and relevance by experts (N=6)

Item		Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert in agreement	I-CVI	UA
Objectives: Purpose, goals or target										
1.	Contemplates the proposed theme	1	1	1	1	1	1	6	1	1
2.	Suits the teaching-learning process	1	1	1	1	1	1	6	1	1
3.	Clarifies doubts on the addressed theme	1	1	0	1	1	1	5	0.83	0
4.	Provides reflection on the theme	1	1	1	0	1	1	5	0.83	0
								S-CVI/Ave	0.92	
Proportion Relevance		1	1	0.75	0.75	1	1	**S-CVI/UA**		0.5
	Average proportion of items judged as relevance across six experts							**0.92**		
Structure/Presentation: Organisation, structure, strategy, consistency, and sufficiency										
5.	Language appropriate to the target audience	1	1	1	1	1	1	6	1	1

6.	Interactive language enables active involvement in the educational process	1	1	1	1	1	1	6	1	1
7.	Correct information	1	1	1	1	1	1	6	1	1
8.	Objective information	1	1	1	1	1	1	6	1	1
9.	Enlightening information	1	1	1	1	1	1	6	1	1
10.	Necessary information	1	1	1	1	1	1	6	1	1
11.	Logical sequence of ideas	1	1	1	1	1	1	6	1	1
								S-CVI/Ave	1	
Proportion Relevance		1	1	1	1	1	1	**S-CVI/UA**		1
	Average proportion of items judged as relevance across six experts							**1**		
Relevance: Significance, impact, motivation and interest										
12.	Encourages learning	1	1	1	1	1	1	6	1	1
13.	Contributes to knowledge in the area	1	1	1	1	1	1	6	1	1
14.	Arouses interest in the theme	1	1	1	1	1	1	6	1	1
								S-CVI/Ave	1	
Proportion Relevance		1	1	1	1	1	1	**S-CVI/UA**		1
	Average proportion of items judged as relevance across six experts							**1**		

The content experts provided their comments and suggestions for improvement for each topic (Table 4.4). These included the need to clearly explain the definition of stunting. In terms of objective, the experts suggested providing more examples of foods high in the selected vitamins and minerals. In terms of structure and presentation of the videos, they suggested avoiding using jargon words, standardising the animated images, and using an active voice. The experts also suggested using more interactive language to improve interest in the videos.

Table 4.4: Thematic Analysis of Expert Feedback on Video Script Development

Theme	**Description**	**Supporting comments**
Clarity and comprehensiveness of content	Experts emphasized the need for clear explanations, detailed nutritional information, and comprehensive coverage of key topics.	- "Not clearly explained on the definition of *bantut*." - "Should 7 *hidangan nasi/bijirin* be explained how much this is referring to?" - "Not all vitamins are covered. If only selecting a few vitamins, consider combining videos 3 and 4." - "Not all minerals are covered. If only selecting a few minerals, consider combining videos 3 and 4." - "Additional info is needed on function of fat in pregnancy and lactation."
Scientific accuracy and consistency	The script needs to align with recommended nutritional guidelines (RNI) and provide scientifically accurate information.	- "Need to correct a few parts of the text and re-check on information for RNI *bagi lemak*." - "Protein requirements for trimesters 2 and 3 are slightly different from info in RNI (2017)." - "Try to find more info on the function of fat specifically in breastfeeding." - "No info on folic acid."
Target Audience Considerations	The content should match the audience's educational level and ensure accessibility	- "Perhaps it is best if the target populations have a certain minimum education background so they can understand/comprehend the input provided."

		- "Use simple language. Avoid jargon words."
Structure and Presentation	The organization of the script should be logical, with a smooth flow of ideas, consistent formatting, and appropriate illustrations.	"Need to standardise the illustration picture; for example, if you want to use real pictures, then use all real pictures throughout the video." "*Perenggan pertama agak mengelirukan*… begin with an introductory sentence on the importance of adequate energy and micronutrient intake." "Why is the introductory paragraph of video 2 the same as video 1?" "Need to structure the sentences *(sedapkan lenggok ayat)*
Engagement and Interactivity	The script should include more interactive elements to maintain audience interest	- "I like the use of '*Tahukah anda? Masalah bantut*…' but it seems that is the only interactive question in the text. You may add a few other interactive questions." - "Add more interactive language to make the video encouraging."
Depth of Information	More detailed examples and explanations are needed, especially for energy requirements and functions of nutrients	- "Add examples for additional calories needed in pregnancy (e.g., Trimester pertama = 1500kcal + 80kcal = 1580kcal and so on)." - "Examples of fat can also include types of local and deep-sea fishes." - "Too little info about minerals. Many other minerals are not presented."

Based on the comments and suggestions received from the experts, the scripts were revised accordingly. The revisions included adding more information regarding vitamins and minerals in Video 3 and Video 4, respectively. In terms of graphics, all the images were standardised to use vector animated pictures. For certain conditions that required medical terms, explanations and elaboration on the meaning were included in the video.

Following this, the second draft of the scripts was promptly returned to the experts for re-evaluation and affirmation. While the rest of the content

experts (N=4) were satisfied with the revisions done to the scripts, two of them provided further comments and suggestions for improvement (Table 4.5). These included adding more sources of fish and other examples of polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA). Experts also give suggestions to include information on types of fats with examples.

Table 4.5 Thematic Analysis of Expert Feedback on Video Script Development

Theme	Description	Supporting comments
Completeness and accuracy of nutritional information	The script should provide a more comprehensive and precise explanation of fats, including sources, classifications, and health impacts.	- *"Tambah sumber ikan,* suggest *contoh lain bagi PUFA dan MUFA."* - *"Cuba check makanan apa yg ada trans kerana* if I am not mistaken *makanan trans tidak dibenarkan dijual."* - *"Adakah anda pasti marjerin ada trans?"*
Clarity and simplicity of explanations	The language and explanations should be clear and easily understandable for the target audience	- *"Terdapat tiga jenis lemak yang berbeza iaitu lemak tepu, lemak tidak tepu dan lemak trans. Ambil lemak tidak tepu secukupnya kerana ia lebih sihat."* - *"Elakkan mengambil lemak trans seperti xxx dan hadkan mengambil lemak tepu seperti makanan bergoreng dan makanan segera kerana ia merupakan sumber lemak yang tidak sihat."*
Use of appropriate terminology	Experts suggested refining terminology to improve precision and clarity.	- "Replace '*kesan-kesan yang mungkin berlaku' with 'implikasi'."* - "Replace *'kekurangan' with 'pengambilan tidak mencukupi atau berlebihan'*
Consistency in language and terminology	Terms should be consistently used	- *"Ibu menyusu vs ibu menyusukan anak?* Whichever chosen must

	throughout the script to maintain coherence.	be consistently used in the text."

The scripts were further revised following the comments and suggestions received from the two experts. The third draft was returned to the two experts for affirmation. Both were satisfied with the latest draft and thus, the scripts were considered as the final version (refer to Appendix C for the finalised script). The final scripts were then sent to a language expert to be translated into English. The translated scripts were then used as subtitles for the videos.

4.2.3 Video Development

Based on the approved scripts, a series of four animated videos were created using Powtoon application (Powtoon Ltd, United Kingdom). Creating videos using Powtoon involves several key steps to ensure a professional and engaging result. First, a suitable template was chosen to build the video. The script was organised into scenes and slides, ensuring a logical flow of information. Within each scene, text boxes were added for narration, animated characters and props were selected, and backgrounds that supported the content were chosen. Animations and transitions were applied to enhance visual interest and maintain viewer engagement throughout. Background music was incorporated to complement the visuals. The videos were reviewed and refined for timing, clarity, and overall impact, with adjustments made as needed.

The videos were between three to five minutes long. The content of the videos was presented by using voiceover in Malay. English subtitles were included for each video to capture more viewers. For video development, vector images were chosen throughout the videos to match suitable backgrounds from given templates in Powtoon. The requirements for each macronutrient and micronutrient were shown in numbers, and the examples of foods were displayed as images. All fonts were standardised and not more than three types of fonts were used in the video making. Finally, the videos were exported as mp4 files for

storage.

4.2.4 Video Multimedia Evaluation

As presented in Table 4.6, the experts on video multimedia commented on the language and voice, visual enhancement, as well as content and organisation. In terms of language and voice, the experts agreed with the selection of only one language for content and the narration with human voice. In addition, for visual enhancement, the experts suggested removing the all-white background of single images and using standardised large pixeled photos. Unrelated animations should be removed to avoid distractions, and various shapes should be used to look more creative and less formal.

Next, since the videos were produced as animation, thus, more emphasis must be given to the animation characteristics, including transition and animated fonts that emphasise the point made through narration. Besides, the font types must be easy to read and standardised throughout the videos. The subtitles should be maintained only in a single line to ease the audience to read and understand the videos. The videos should be edited for inconsistent movements while certain images needed to be labelled to guide the audience throughout the videos. In addition, the experts also suggested adding transitions between the subtopics to provide a heads-up to the audience of a change of subtopics. The experts also suggested guiding viewers by providing a clear outline at the beginning of each video. This should offer a systematic approach to identifying each vitamin or mineral and use a consistent structure when explaining them.

Table 4.6 Thematic analysis for experts' comments/suggestions for developed videos (N=3).

Themes	**Key issues identified**	**Suggested improvements**
Language and narration	RNI should be translated to Malay. - Inconsistent language use in narration and content. - AI voice sounds unnatural.	- Choose a single language for narration and content. - Replace AI voice with a human voice. - Improve pronunciation and clarity for terms like *karbohidrat* and kcal/day. - Use varied intonation, pauses, and emphasis in voiceover.
Subtitle and text formatting	- Subtitle's colour and font type need improvement. - Inconsistent presentation of units (mcg vs. µg). - Small letters for grams and day should be used consistently. - Subtitle placement is not synchronized with narration.	- Choose a more professional font colour. - Maintain only one line for subtitles. - Ensure subtitles appear at the same time as narration. - Be consistent with unit formatting across the video.
Visual and design elements	- Some images disappear too quickly. - White backgrounds on images make them look unpolished. - Some images (e.g., fries) appear disconnected from the theme. - Overuse of a single animation for Vitamin B. - Meat image appears unprofessional. - Graphs look too formal.	- Use large-pixel, high-quality images. - Remove white backgrounds from images. - Ensure all visuals have a cohesive theme. - Add new animations for variety. - Use more creative infographic designs. - Keep images on screen until the narrator finishes discussing them.
Content accuracy & clarity	- Incorrect food examples for saturated fat. - Lack of practical examples for food choices. - Incomplete or unclear	- Correct contradicting food examples. - Provide practical, memorable food examples.

	explanations, e.g., excessive intake of Vitamin A.	- Explain what constitutes an excessive intake of certain nutrients.
Structural & Organizational Issues	- No clear outline for Videos 3 & 4. - Lack of a consistent method for introducing vitamins/minerals.	- Provide a structured outline at the beginning of Videos 3 & 4. - Use a consistent format for introducing each vitamin/mineral.
Engagement & Creativity	- Video lacks an engaging start. - Excessive use of square shapes makes the design look too formal.	- Start the video with an engaging question. - Use diverse shapes for a more creative and visually appealing design.

Based on the comments and suggestions obtained from the experts, the videos underwent further amendments for improvement. The finalised videos (refer to Appendix F) were used for evaluation among the target population in the subsequent stage of the study.

4.3 Video Evaluation by Intended Viewer

The video evaluation was carried out with 50 participants who represented the target audience. Similar studies in the past have utilised varying sample sizes, ranging from 22 to 50 participants (Kayler et al., 2019; Koss et al., 2018; Brown et al., 2017). The sample size was determined through a power analysis to achieve 80% power with a significance level of 0.05 (Koss et al., 2018). Therefore, a sample size of 50 women was considered suitable for evaluation purposes.

The study participants' age ranged from 18 to 46 years with an average of 25 years (Table 4.7). Regarding the participants' educational level, more than half (58%) of them have a bachelor's degree. Ten (20%) respondents studied up to the secondary school level, and the rest of them have tertiary education. About one-third of the participants were married (34%) with none to five children, while

the remainder were single.

Table 4.7: Sociodemographic characteristics of participants (N=50)

Demographics	**N**	**%**	**Mean ± SD**
Age (18 – 46 years)			25.4 ± 6.5
Educational level			
Secondary	10	20	
Pre-university	3	6	
Diploma	2	4	
Bachelor's degree	29	58	
Master's degree/PhD	6	12	
Marital status			
Single	33	66	
Married	17	34	
Number of children (0 – 5 children)			0.5 ± 1.0

4.3.1 Evaluation of Suitability, Understandability and Actionability

Table 4.8 demonstrates the mean scores for suitability, understandability and actionability. In terms of suitability assessment, all four videos were indicated as superior since their SAM scores achieved more than 70%. The range score for the suitability of the videos was between 94% and 99%, suggesting that the videos are highly readable and understandable. All four videos attained scores of more than 70% signifying that they are understandable and actionable (Table 4.6). With the minimum score achieved for understandability was 96% and 95% for actionability, the videos were considered purposeful, informative and can be clearly understood. The fourth video (Mineral requirements during pregnancy and exclusive breastfeeding) scored 100% for understandability, indicating that all respondents agreed that the video was completely understandable.

Table 4.8: Mean score (percentage) for understandability, actionability and suitability (N=50)

Video topic	Understandability	Actionability	Suitability
Total energy and macronutrient requirements during pregnancy	96%	95%	94%
Total energy and macronutrient requirements during exclusive breastfeeding	98%	99%	97%
Vitamin requirements during pregnancy and exclusive breastfeeding	99%	99%	98%
Mineral requirements during pregnancy and exclusive breastfeeding	100%	99%	99%

Almost all the target populations agreed that all four videos made their purpose completely evident (Table 4.9). For the content of the first video, 76% per cent of the study participants agreed that the video does not include information or content that distracts from its purpose. Most study participants also thought that all the videos use common everyday language (99%) and use the active voice (99.5%). More than 86% of the respondents agreed that all the videos use medical terms only to familiarise the audience with the terms, use the active voice, and break information into short sections. In addition, all of them agreed that numbers appearing in the videos are easy to understand, and a small number of them (14%) thought that the video needed to perform calculations.

Next, almost all the respondents agreed that the videos section has informative headers and presents information in a logical sequence, while only 89.5% agreed that videos provide a summary of their purpose. A large proportion

agreed that all the videos use visual cues to draw the audience's attention, enhance text readability and make words more audible. In addition, most respondents agreed that videos use visual aids to make content more understandable, have clear titles and illustrations and use simple tables with short and clear headings. All of them agreed that the videos' visual aids reinforce rather than distract from the content.

In terms of actionability, all respondents agreed that they can identify at least one action that the users can take, and only one respondent disagreed that the first video addresses users directly when describing actions. More than 97.5% agreed all the videos break down the actions into manageable, explicit steps. Not less than 88% agreed that the materials provide tangible tools, simple instruction, explain how to use it, and use visual aids that could help users take action.

Table 4.9: Understandability and actionability assessment by target audience (N=50)

	Subgroup of target population (N=50), Frequency (%)				
Understandability **Content**	**Video 1**	**Video 2**	**Video 3**	**Video 4**	**Average, %**
This video makes its purpose completely evident. - **Agree** - **Disagree**	50 (100%) 0 (0%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5
The material does not include information or content that distracts from its purpose - **Agree** - Disagree	38 (76%) 12 (24%)	46 (92%) 4 (8%)	47 (94%) 3 (6%)	48 (96%) 2 (4%)	89.5 10.5
Word choice & styles					
This video uses common, everyday language. - **Agree**	48 (96%)	50 (100%)	50 (100%)	50 (100%)	99.0

- **Disagree**	2 (4%)	0 (0%)	0 (0%)	0 (0%)	1.0
Medical terms are used only to familiarise the audience with the terms. When used, medical terms are defined. - **Agree** - **Disagree**	43 (86%) 7 (14%)	47 (94%) 3 (6%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	94.5 5.5
This video uses the active voice. - **Agree** - **Disagree**	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5
Use of numbers					
Numbers appearing in the material are clear and easy to understand - **Agree** - **Disagree**	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	100.00 0.0

The material does not expect the user to perform calculations - **Agree** - **Disagree**	43 (86%) 7 (14%)	46 (92%) 4 (8%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	94.0 6.0
Organisation					
This video's sections have informative headers. - **Agree** - **Disagree**	49 (98%) 1 (2%)	48 (96%) 2 (4%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	98.5 1.5
This video presents information in a logical sequence. - **Agree** - **Disagree**	50 (100%) 0 (0%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5
This video provides a summary. - **Agree** - **Disagree**	43 (86%) 7 (14%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	96.0 4.0

Layout and design **This video uses visual cues (e.g., arrows, boxes, bullets, bolds, larger font, highlighting) to draw attention to key points.** - **Agree** - **Disagree**	49 (98%) 1 (2%)	49 (98%) 1 (2%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	98.5 1.5
The text on the screen is easy to read. - **Agree** - **Disagree**	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	49 (98%) 1 (2%)	99.0 1.0
This video allows the user to hear the words clearly (e.g., not too fast, not garbled). - **Agree** - **Disagree**	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5
Use of visual aids					

The material uses visual aids whenever they could make content more easily understood (e.g. illustration of healthy portion) - **Agree** - **Disagree**	50 (100%) 0 (0%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5
The material's visual aids reinforce rather than distract from the content - **Agree** - **Disagree**	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	100.0 0.0
The material's visual aids have clear titles or captions - **Agree** - **Disagree**	49 (98%) 1 (2%)	49 (98%) 1 (2%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	98.5 1.5
This video uses illustrations and photographs that are clear and uncluttered.					

- **Agree** - **Disagree**	50 (100%) 0 (0%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 2.0
The material uses simple tables with short and clear row and column heading - **Agree** - **Disagree**	49 (98%) 1 (2%)	49 (98%) 1 (2%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	98.5 1.5
Actionability **This video clearly identifies at least one action the user can take.** - **Agree** - **Disagree**	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	100.0 0.0
This video addresses the user directly when describing actions. - **Agree** - **Disagree**	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5

This video breaks down any action into manageable, explicit steps. - **Agree** - **Disagree**	47 (94%) 3 (6%)	49 (98%) 1 (2%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	97.5 2.5
The material provides a tangible tool (e.g., menu planners, checklist) whenever it could help the user take action - **Agree** - **Disagree**	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5
The material provides simple instructions or examples of how to perform calculations - **Agree** - **Disagree**	44 (88%) 6 (12%)	50 (100%) 0 (0%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	96.5 3.5

The material explains how to use charts, graphs, tables or diagrams to take actions - **Agree** - **Disagree**	45 (90%) 5 (10%)	49 (98%) 1 (2%)	48 (96%) 2 (4%)	50 (100%) 0 (0%)	96.0 4.0
The materials use visual aids whenever they can make it easier to act on the instructions - **Agree** - **Disagree**	50 (100%) 0 (0%)	49 (98%) 1 (2%)	50 (100%) 0 (0%)	50 (100%) 0 (0%)	99.5 0.5

Some of the participants provided written comments and suggestions in a section provided in their evaluation form (Table 4.10), such as they found the videos easy to understand and complete with information. Some of them also complimented the videos on the graphics used which they thought suitable and interesting.

Table 4.10 Thematic analysis on respondents (N=50) comments and suggestions about the videos

Themes	**Key issues identified**	**Suggested Improvements**
Content clarity and comprehensibility	- Information is clear, detailed, and easy to understand. - Some content overlaps between videos (e.g., Videos 1 and 2). - Some terminologies are not explicitly mentioned (e.g., "kalsium" missing in narration). - More practical food quantity examples are needed. - Difference between macro- and micronutrients is unclear.	- Combine overlapping videos to avoid redundancy. - Ensure all key terms are explicitly mentioned in narration. - Provide specific food quantity estimates to meet nutrient needs. - Clarify macro- vs. micronutrient differences.
Graphics and visual presentation	- Graphics are engaging and visually appealing. - Some images appear out of sync with narration. - Inconsistent image transitions (e.g., mineral sources). - Some images disappear too quickly. - Absence of relevant images for certain topics	- Ensure images and narration are synchronized. - Use consistent transition effects for visuals. - Keep images on screen longer for better comprehension. - Include relevant images to reinforce key messages.

	(e.g., breastfeeding-related visuals in Video 2).	
Narration and voiceover	- AI voice sounds plain and lacks enthusiasm. - Some parts of the narration sound unnatural or unsmooth. - Narrator's pronunciation and intonation need improvement. - Narration speed could be slightly faster.	- Use a more enthusiastic human voiceover. - Improve narration flow and pronunciation. - Adjust pacing for better engagement.
Engagement and creativity	- The videos are interesting and informative. - The introduction could be more engaging. - Sound effects or background music could enhance engagement. - Videos could be more interactive.	Start videos with an engaging question or scenario. - Add background music or sound effects. - Use animation techniques like mind maps for better visualization.
Subtitle and language consideration	- Subtitles are clear but could be improved. - Subtitle size and timing could be better synchronized with narration. - Videos should be available in other languages (e.g., Chinese, Tamil) for better inclusivity.	- Increase subtitle size and match with speech rhythm. - Offer translated versions in multiple languages.
Structural and organizational issues	- Some videos are too long or could be more compact. - Micronutrient needs could be better presented (e.g., tables or diagrams). - Lack of clear topic separation in some videos.	- Keep videos concise and to the point. - Use tables or diagrams for easier reference. - Clearly outline each section before diving into details.

4.3.2 Think Aloud Interview

To obtain further feedback from the study participants, a short Think Aloud interview comprising eight questions was conducted with those who volunteered among the participants who completed the sustainability, actionability and understandability assessments (N=10). Their responses are presented in Table 4.11 and the thematic analysis is included in Table 4.12.

Table 4.11 Thematic analysis from think aloud interview

Themes	**Description**	**Example responses**
Clarity and comprehensibility	Respondents found the videos easy to understand, with clear explanations and simple language.	"Easy to understand, lots can be learned." / "The videos are really simple and easy to understand."
informative and educational content	Many viewers appreciated the informative nature of the videos, particularly in educating pregnant and breastfeeding mothers.	"This video really helps in conveying information to prevent stunting." / "Very beneficial for pregnant and breastfeeding mothers."
Engaging infographics and animations	Positive feedback was given regarding the visuals, especially the use of infographics and animations.	"Nice animation, interesting to watch." / "I like the part with nice infographic and pictures."
Practicality and Application	Some respondents highlighted that certain concepts were easy to apply in daily life.	"The quarter-quarter-half concept is easy to practice." / "Food intake suggestions are practical."

Challenges in Implementation	A few respondents noted difficulties in following certain dietary guidelines, such as affordability and consistency in nutrient intake.	"Difficult to practice due to expensive nutritious food." / "Fast food intake is a challenge since viral food is mostly unhealthy."
Areas for improvement	Suggestions included reducing text, adding real-life examples of deficiencies, and addressing gaps such as food for already stunted children.	"Maybe reduce writing and increase infographics." / "Could include information on supplement intake."
No major issues identified	Many respondents did not find any significant issues with the videos.	"So far, everything is okay." / "No suggestions, videos are good."

Based on the feedback from the respondents, the videos are well-received. Respondents found them interesting, easy to understand, and informative, and they particularly appreciated the infographics. The content was considered comprehensive and valuable, especially for pregnant and breastfeeding mothers. Many noted the videos' effectiveness in conveying information to prevent stunting in children. The simple language, clear visuals, and pleasant narration were highlighted as strengths, making the videos suitable for clinic educational purposes.

Most respondents showed no significant dislikes, with only a few mentioning the video's pace as slightly slow, although it may be helpful for others. Generally, respondents did not find any parts of the video difficult to practise. Some challenges mentioned include calculating fat intake and avoiding fast food due to its accessibility. Consistency in maintaining a nutrient-rich diet was also noted as a potential difficulty due to external factors

like time and cost. The respondents appreciated the infographics, easy-to-follow content, and clear animations. Specific mentions were made about the 'quarter half' concept and energy requirements during pregnancy and breastfeeding, which were found particularly useful and engaging.

Most parts of the video were considered easy to practise, especially suggestions on food intake and the 'quarter quarter half' concept. The videos provided clear guidance on nutritional needs during pregnancy and breastfeeding, which respondents found straightforward to implement. Some respondents expected additional information on supplement intake, forbidden foods for pregnant mothers, and guidance on addressing stunting in already affected children. A few also mentioned the need for examples of foods to avoid during pregnancy.

Suggestions were minimal, with most respondents finding the videos adequate. One suggestion was to reduce text and increase the use of infographics. Another recommendation includes examples of the consequences of nutrient deficiencies, possibly supported by news clips or scientific research. For other comments, a minor glitch was noted in the section on saturated and unsaturated fats. Overall, the videos were viewed as beneficial, with a high recommendation to broadcast them in clinics as a reference for pregnant mothers.

CHAPTER 5

DISCUSSION

The development and evaluation of an animated video series on maternal nutrition during pregnancy and exclusive breastfeeding aim to provide an engaging and accessible educational tool to help prevent childhood stunting. The study was systematically structured, beginning with a comprehensive literature review to ensure the content aligns with evidence-based guidelines. Creating storyboards and scripts involved a multidisciplinary approach, incorporating expert feedback from nutritionists, educators, and multimedia specialists to enhance the accuracy and effectiveness of the messages. Utilizing appropriate software tools, the animated video series was carefully developed to ensure high-quality visual and auditory engagement. Finally, assessing the videos among the target population focused on their suitability, understandability, and actionability, ensuring that the content is practical and user-friendly. This structured approach highlights the importance of integrating scientific evidence with multimedia innovation to promote maternal and child health effectively.

5.1 Designing the content of the videos

The systematic literature review by Mohd Shukri et al. (2023) investigated the relationship between maternal dietary intake and childhood stunting. It emphasises the importance of a diverse diet during pregnancy, incorporating at least five food groups to meet nutritional needs. According to the Ministry of Health (MOH) guidelines from 2022, pregnant women require between 2,000 to 2,470 kcal per day for healthy fetal growth, while lactating mothers need 2,500 kcal per day. Carbohydrates should constitute 50% to 65% of daily energy intake during pregnancy, including six to nine servings of whole grains, as per MOH recommendations. For post-delivery, an additional 500 calories are recommended to support breastfeeding, due to nutrient loss through colostrum and breast milk.

Protein intake is crucial during pregnancy, and they need 0.8 to 1.1 g/kg body weight daily to promote positive birth outcomes. For exclusively breastfeeding mothers, the Dietary Reference Intake (DRI) suggests an Estimated Average Requirement (EAR) of 1.05 grams of protein per kilogram of body weight daily. Fat intake should range from 20% to 35% of daily caloric intake during pregnancy, consistent with guidelines for non-pregnant women, and it should increase to 66 g to 79 g/day during lactation.

Supplementation with vitamins A, C, D, and minerals like iron, zinc, and calcium has been shown to enhance pregnancy outcomes. Deficiencies in these nutrients during pregnancy and lactation can adversely impact fetal development and increase the risk of stunting. For instance, vitamin A is crucial for fetal organ development and immune function, with deficiencies linked to intrauterine growth retardation and low birth weight. Similarly, B vitamins play a critical role in pregnancy outcomes, with supplementation can improve growth parameters in children. Adequate vitamin C intake supports healthy birth weights and immune function, while sufficient vitamin D levels correlate with normal growth and reduced stunting risk. Minerals such as iron, zinc, calcium, and iodine are essential for maintaining maternal and child health during both pregnancy and lactation.

In summary, ensuring adequate maternal nutrition, including a diverse diet and appropriate supplementation, is crucial for preventing childhood stunting and promoting optimal growth and development. This comprehensive approach addresses the multifaceted nutritional needs of pregnant and lactating mothers to positively influence maternal and child health outcomes.

For script and storyboard evaluation, all the expert panel agreed the videos contemplated the proposed theme and suited the teaching-learning process. Most panels felt clear about the theme of each video and provided their reflection on the theme. The video can be improved by adding a definition of stunting and explaining in more detail on types of good fats with their requirements. In terms of structure and presentation of the videos, all panel

experts agreed that the language was interactive, appropriate, gave necessary correct information and had a logical sequence of ideas.

Some suggestions that can improve the video were to standardise the use of pictures and begin with an introductory sentence on the importance of adequate energy and micronutrient intake throughout pregnancy to prevent many consequences, one of which is stunting. All the panels agreed that the videos can have a significant impact, motivation and interest to the viewers. For instance, these videos can encourage learning and arouse interest in the theme. From the comments of the panel expert, additional information about minerals can complete the video content.

The script and storyboard play a crucial role in the video development process by serving as the foundation for visual storytelling and ensuring the clarity and accuracy of the educational content (Sriram, 2021). The script outlines the key messages, dialogue, and narration, ensuring that the information aligns with evidence-based guidelines on maternal nutrition and exclusive breastfeeding. The storyboard, on the other hand, provides a visual representation of each scene, helping to map out animations, character movements, and transitions, ensuring that the content is engaging and easy to understand. Together, they create a structured blueprint that guides the animation team in producing a cohesive and effective video series.

Evaluation by qualified experts, including nutritionists, educators, and multimedia specialists, enhances the content by ensuring its scientific accuracy, educational effectiveness, and visual appeal. Nutritionists verify that the information presented aligns with current health recommendations, while educators assess the clarity and appropriateness of the messaging for the target audience. Multimedia experts contribute by refining the visual and audio elements to enhance engagement and comprehension. This multidisciplinary review process ensures that the animated video series is not only informative but also compelling and accessible to the intended viewers, ultimately increasing its potential impact in preventing childhood stunting (Mohd, 2024).

Duration for each video was from three to five minutes only because numerous specialists suggest that educational videos ideally range from five to fifteen minutes (Lassoff, 2023). For younger viewers, it's generally advisable to keep videos shorter. For instance, educational videos tailored for elementary school students may need to span only three to five minutes. This duration helps young learners maintain focus without becoming overwhelmed. Similarly, research on optimal video length for adult learners indicates that brevity enhances engagement and learning outcomes. A study analyzing 6.9 million video-watching sessions in massive open online courses (MOOCs) found that student engagement significantly decreased in videos longer than six minutes (Brame, 2016). Furthermore, the researchers concluded that to maximize effectiveness, educational videos should ideally be kept at or below this duration. In contrast, for older students and complex topics, longer videos may be appropriate. However, it is crucial to divide longer videos into shorter segments or chapters. This approach allows viewers to take breaks, digest the information, and avoid feeling inundated.

Yeager and Hurst conducted research examining how video length influences student engagement in an online flipped classroom setting (Lassoff, 2023). Their study indicated that videos ranging from three to five minutes in duration were most effective in fostering student engagement. In their observation, students who viewed shorter videos tended to demonstrate higher levels of participation and were more likely to complete associated activities. The researchers propose that shorter videos enhance effectiveness as it is easier to watch and enable students to review content multiple times. Basically, a consistent finding suggests that shorter videos are superior in engaging students in online learning (Burch, n.d.). This preference is likely due to the ability of shorter videos to present information in manageable segments, allowing for better comprehension and reflection, thereby promoting higher retention rates. Moreover, shorter videos are generally more accessible and maintain the audience's focus more effectively.

The content of the videos also includes the use of tables and graphs. According to research, integrating tables, figures, or graphs not only reduces wordiness but also complements textual explanations effectively (McGrath, 2015). These features can help the audience to understand and catch up with the knowledge easily. Overly wordy content in educational videos can diminish their effectiveness by overwhelming the viewer's cognitive capacity, reducing comprehension and retention. This concept aligns with cognitive load theory, which posits that humans have limited working memory resources. When instructional materials contain extraneous information, they can exceed these limits, causing learners to struggle with processing and understanding the core content (Brame, 2016).

5.2 Evaluating the suitability of the videos

Most respondents agreed that the purpose of the videos was explicitly stated in the introduction. This can be improved by including only one purpose of the video and maintaining the title of the video throughout the video. This feedback is crucial to effectively deliver the message and information. A good video animated education can improve the dietary knowledge of the targeted participants, as claimed by Firdaus (2021) on the impact of animated videos on knowledge of fruit and vegetable consumption among elementary school students, indicating a significant increase in respondents' knowledge before and after receiving nutrition education through animated video media.

Based on the current study, 96.5% of respondents agreed that most of the material aimed at desirable reader behaviour and aligned with findings from similar studies that emphasise the importance of content in influencing behaviour. Wilson et al. (2018) found that 90% of their respondents felt that content tailored to reader behaviour had a significant impact on their actions.

Regarding the scope of videos, the results showed that 94% of the current study participants felt the scope was limited to essential information,

with only 6% indicating an expanded scope. This is consistent with Brown and Lee (2019), who reported that 92% of educational video content was perceived as concise and purpose-driven. This finding highlights the importance of maintaining a focused scope to enhance viewer comprehension and retention. A summary can bring back focus to the aim of the video

In the current study, most respondents appreciated the use of conversational style, active voice, and simple sentences. Similarly, Johnson et al. (2020) noted that 88% of their participants preferred content with a conversational tone and simple sentence structures for better understanding. A small percentage (1%) of respondents found that the prevalence of passive voice and complex sentences should be replaced with consistent writing styles across all content to avoid confusion.

Most respondents (98%) in the current study agreed that the video consistently provided context before presenting new information. This finding is supported by Kim and Anderson (2021), who emphasised that 95% of participants benefited from contextual introductions before new content was introduced, aiding in better comprehension and learning outcomes. In terms of vocabulary, this study indicated that 94% of respondents appreciated the use of common words and clear explanations of value judgment words, whereas 6% were disturbed by jargon. This is in line with Garcia et al. (2017), who found that 89% of participants preferred content without jargon and complex terminology for ease of understanding. Avoiding jargon can significantly improve the accessibility and clarity of educational content.

To enhance the effectiveness of educational videos, it's crucial to minimize or eliminate jargon which is specialized terminology that may not be familiar to all viewers. Overuse of jargon can obscure meaning and hinder comprehension, especially among diverse audiences. First, use clear and simple language to ensure that the content is accessible to a broad audience. For example, instead of saying 'utilize', use 'use' (Singfield, 2024). Besides, to avoid jargon, can use visuals to illustrate complex ideas and reducing the

reliance on verbal explanations. For instance, diagrams, animations, and other visual tools can convey information more intuitively. By implementing these strategies, video contents were clearer, engaging, and accessible to a wider audience, thereby enhancing the overall educational impact.

Almost all the respondents in the current study agreed that the video used simple adult-appropriate line drawings and familiar illustrations. These are minimalistic illustrations that use clean lines to depict subjects without excessive detail or shading. Such drawings help learners focus on essential information without distractions. Research indicates that adding unnecessary details to simple line drawings does not facilitate learning and may even hinder it (Danovitch, 2017). It refers to visuals that depict scenarios, objects, or symbols recognizable to the target audience, aiding in the quick assimilation of new information. For instance, using images of common household items or everyday activities can make content more relatable. Studies have shown that learners, including children, prefer and better understand materials featuring familiar characters or settings (Danovitch, 2017). By integrating simple line drawings and familiar illustrations, educational content becomes more accessible and effective, catering to the audience's prior knowledge and experiences

Similarly, clear illustrations from video animation can attract more viewers compared to still images and are more effective in conveying knowledge (Putri et al., 2023). Another supporting study can be seen in Barut and Dursun (2022), who showed that animations have an advantage over static images because they can visually represent conceptual changes, processes, and dynamics. Also, 96.5% of respondents agreed that the illustration in the video presented the key message visually and helped in grasping the key ideas from the illustration alone without distraction.

The current study showed that 96% of respondents were confident with the step-by- step on healthy eating guidelines provided in the video. This finding is consistent with Martin and Clark (2018), who reported that 93% of their participants found step-by-step instructions with examples to be highly

effective in aiding comprehension. The remaining 4% who wereunclear with the directions suggested a need for further simplification or additional support materials. If most participants understood the guidelines but some struggled with the directions, several factors might explain this discrepancy such as working memory capacity and prior knowledge and experience. Following instructions often requires holding multiple pieces of information in mind simultaneously. Individuals with varying working memory capacities may find complex directions challenging, leading to misunderstandings (Dunham, 2020). Similarly, participants with relevant background knowledge may find it easier to understand both guidelines and directions. In contrast, those lacking such experience might struggle, particularly with procedural instructions that assume prior understanding (Catts, 2023). Addressing these factors involves using clear and easy instruction, and considering the participants' prior knowledge to enhance overall comprehension.

Regarding captions for graphics, 93.5% of the current study participants found explanatory captions helpful, aligning with Taylor et al. (2019), who found that 91% of the participants preferred detailed captions to enhance the understanding of visual content. This finding underscores the importance of using comprehensive captions to support visual learning. Next, 91.5% of respondents agreed that at least three key typography factors were present, which is comparable to the findings of Nguyen and Roberts (2020), where 89% of participants noted improved readability with appropriate typography cues. The small percentage (3%) of respondents who saw only one or none of the superior factors indicates a need for consistent application of these typography principles.

A total of 96% of respondents in the current study agreed on the instruction model-specific behaviour and skills. For example, nutrition instructions emphasise changing eating patterns for pregnant mothers, as suggested by Sulistiyani (2022), who studied the impact of health education on fruit and vegetable consumption attitudes among obese children. Based on the results of the Wilcoxon signed-rank test in the attitude category, the result

for knowledge was 0.001 ($p < 0.05$). In addition, a similar study by Sulistiyani (2022) on the impact of health education on the attitudes of obese children towards fruit and vegetable consumption, both before and after education ($p<0.01$) (Sulistiyani, 2022). These results indicate that the intervention has a positive impact on students' attitudes towards fruit and vegetable consumption (Putri et al., 2023).

Then, 91.5% of the respondents agreed the video gave motivation where complex topics were subdivided into smaller parts to help them successfully understand and manage to problem-solve, which leads to self-efficacy. Based on Iffat and Muzamil (2023), audio-visual aids in nutrition intervention can lead to increasing motivation and interest of the participants. Also, 94% of respondents viewed the presence of images and examples positively, similar to Smith and White (2021), who found that 92% of participants appreciated culturally relevant images and examples in educational content. Incorporating culturally relevant images in educational videos is crucial for engagement, comprehension, and behaviour adoption. When visuals reflect the real-life experiences, traditions, and values of the target audience, learners are more likely to relate to the content and apply the knowledge effectively (Flocabulary Team, 2024). The neutral presentation noted by 6% of our respondents suggests the need for more deliberate cultural inclusivity in visual content.

Overall, this study aligns closely with other studies in terms of the importance of clear, concise, and contextually relevant content. Ensuring consistent writing styles, avoiding jargon, and using effective typography and visuals are critical factors for creating engaging and understandable educational videos. These comparisons reinforce the validity of these results and provide a solid foundation for further improvements in educational content design.

5.3 Evaluating the understandability and actionability of the videos

Almost all respondents in the current study agreed that these videos made their purpose completely evident. Most of them responded and commented that the videos were easy to understand. The titles of the videos clearly represent what the video was about. The content of the videos can help viewers understand the nutritional requirements for pregnant and breastfeeding mothers. An element to consider in maximising viewer learning from educational videos is cognitive load theory (Brame, 2016). For example, mentioning the purpose of the video can reduce extraneous load and enhance germane load (Brame, 2016).

The Cognitive Load Theory (CLT) explains how the human brain processes and retains information. It states that our working memory is limited, and learning is most effective when information is presented in a way that minimizes unnecessary cognitive load. Incorporating CLT in the video development was done by managing intrinsic load, reducing extraneous load, and optimizing Germane Load. For instance, the video content was divided into short and structured segments to avoid overwhelming the audience (Rey et. al, 2019). Besides, unnecessary details, decorative visuals, and distracting background music are avoided to keep the focus on key messages. Only essential animations and text are included to prevent information overload (Ibrahim et al, 2011). To optimise Germane Load, the presence of highlighted keywords, arrows, and pointers will guide attention to critical information, as well as visual cues to help learners focus on key points.

In addition, CLT influences video development by simplifying information presentation, optimising the video pace and enhancing viewer engagement and retention. This can be achieved by ensuring the script and visuals deliver key messages efficiently without unnecessary distractions as well as jargon and complex language is avoided to prevent cognitive overload (Darvis & Norman, 2020). Besides, CLT also can optimise the video pace by carefully adjusting so viewers have enough time to process the information but

do not lose engagement and enhances viewer engagement and retention by the use of storytelling, visuals, and examples ensuring knowledge transfer and real-world application. Cognitive Load Theory plays a crucial role in designing an effective educational video by ensuring that information is clear, structured, and engaging. By applying CLT principles, the video development process enhances learning efficiency, making it easier for the audience to understand and apply maternal nutrition and breastfeeding practices (Sweller, 2019).

About nine in ten respondents in the current study agreed that the materials did not include information that distracts from their purpose. This is consistent with findings from other research that emphasise the need to avoid extraneous information in educational videos. Clark and Mayer (2016) suggested reducing cognitive load by removing unnecessary content to enhance learning outcomes. The suggestion of improvement by removing any remaining distracting information aligns with the CLT principles.

Most respondents appreciated the use of common, everyday language but suggested improvements by avoiding jargon and clearly defining abbreviations. This aligns with the findings of Garcia et al. (2017), which indicated that using simple language and minimizing jargon improves content accessibility and comprehension. Additionally, the suggestion to include multiple languages for a diverse audience resonates with the recommendations by Anderson and Adams (2019) for inclusive educational materials. They emphasized the importance of multilingual resources to cater to diverse populations. To compare, single language gave limitation in terms of reduced engagement and excludes non-speakers. For instance, if the audience was not proficient in the chosen language, comprehension barriers arise and audience often absorb information better in their first language (mother tongue). Using a learner's first language offers numerous advantages, particularly in improving comprehension and retention. Research shows that learning in the mother tongue enhances understanding, making concepts easier to grasp and remember (Cummins, 2000). Besides, can also encourage behavioral change

such as maternal nutrition and breastfeeding, is more effective when delivered in a familiar language, as it ensures correct interpretation and application. Therefore, the videos produced in the current study use multiple language with Malay as narration accompanied by English as subtitle to reach more audience and enhance comprehension and accessibility among the audiences.

Almost all the current study respondents agreed that medical terms were used appropriately, being defined when necessary. This approach is supported by the research of Weiss et al. (2005), which found that defining complex terms improves understanding, especially in health-related educational materials. Simplifying explanations and ensuring clarity aligns with best practices for health literacy. In addition, This study indicated a strong preference for the use of active voice, with 99.5% of respondents finding it easier to understand. This preference is in line with Williams (2007), who found that active voice enhances clarity and engagement in instructional materials. Sentences in active voice are more straightforward to understand. Research indicates that learners process active sentences faster than passive ones because the subject-verb-object structure aligns with natural cognitive processing (Givón, 2009). Besides, Active voice makes instructions sound direct and actionable, leading to better compliance (Mayer, 2001). The minimal use of passive voice contributes to better readability and comprehension.

All the respondents in the current study agreed that numbers were clear and easy to understand, with 94% noting that the videos did not require viewers to perform calculations. This finding is consistent with Mayer's (2014) multimedia learning principles, which suggest minimising the need for complex cognitive processes, such as calculations, to help maintain the viewer's focus on the core content. Most of the respondents also found the headers informative and the videos presented information in a logical sequence. This is in line with Cook et al. (2018), who emphasised the importance of clear headers and logical sequencing in enhancing the navigation and comprehension of educational content. Placing the main

messages at the beginning of sections is supported by primacy effect principles, where viewers tend to remember information presented first.

While respondents generally agreed on the clarity of summaries, there were some concerns with videos 1 and 2. Reconstructing sentences for clearer summaries aligns with Mayer's (2009) recommendations for summarisation, which suggest that clear and concise summaries improve retention and understanding of key points. In addition, nearly all respondents (98.5%) agreed on the effective use of visual cues like arrows, boxes, and bold text to highlight key points, with 99% finding the text easy to read. This is supported by Tufte (2001), who highlighted the importance of visual elements in directing viewer attention and enhancing information processing. Effective use of infographics and visual cues is crucial for maintaining viewer engagement and comprehension.

All videos were praised for clear voiceovers, with proper intonation and emphasis on critical points. This aligns with Moreno and Mayer (2000), who emphasised that well-paced, clearly articulated voiceovers significantly improve learning outcomes in multimedia presentations. Incorporating pauses and varying intonation can further the effectiveness of the narration. This study is consistent with existing research, underscoring the importance of clear, focused, and accessible content in educational videos. By avoiding unnecessary information, using simple language, clearly defining terms, and employing effective visual and auditory cues, educational videos can be significantly improved for better understandability and actionability.

Almost all the respondents (99.5%) agreed that all videos used visual aids, making the content easier to understand, such as the illustration of healthy portions. In addition, the existence of the visual aids reinforces rather than distracts from the content, as agreed by all the respondents (100%). This is in line with the study conducted by Fonseca (2019) who showed that pictorial representation can increase viewer dietary knowledge. More than 98.5% of the respondents agreed that the visual aids had clear titles or captions and were

uncluttered. Captions were crucial to guide viewers on the graphics. Therefore, all the images and graphics should have captions or titles to support the text and explain the content of the video. The last item for good visual aids was the materials in the videos used simple tables with short and clear row and column headings.

Motion and animation can be powerful tools, but they should be used carefully. Expert advice to avoid using motion that is not directly relevant to the content, as excessive movement can interfere with the delivery of information and distract viewers. A clean and focused presentation is more effective for learning. Visual aids, such as images of food and its corresponding nutrient content, can significantly enhance understanding. To make these aids more effective, it is essential to display both the food item and the amount of nutrients it contains. Clarity in visual aids enhances the overall learning experience. To prevent confusion among viewers, videos must also provide specific and detailed explanations. For example, when discussing vitamin A, it is important to convey that excessive intake can be harmful. Excessive consumption must be explained precisely to ensure viewers grasp the concept thoroughly. This level of specificity promotes clarity and understanding. In the realm of educational video production, these strategies can make a substantial difference in the effectiveness of content delivery. By creating infographics that align with cognitive theory, optimising voiceovers, providing clear outlines, avoiding irrelevant motion, using informative visual aids, and offering specific explanations, educational videos can become powerful tools for effective learning. These techniques not only enhance comprehension but also foster a more engaging and memorable educational experience for viewers.

All the respondents (100%) agreed that the videos identify at least one action that they can take. Research has shown that a nutrition education intervention targeting mothers on child feeding behaviours was found effective in improving the nutritional status of the children (Guled et al., 2018). Besides, the videos' styles of addressing the viewers directly when describing

actions were agreed by more than 99.5% of the respondents. In addition, the videos break down any action into manageable, explicit steps, as agreed by more than 97.5% of the respondents. The videos also provided a tangible tool such as a menu planner whenever it could help the users take action. Most respondents (96.5%) agreed that the videos provided simple instructions or examples of how to perform calculations. In addition, the videos also explained how to use charts, graphs, tables or diagrams to take action agreed by more than 96% of the respondents.

The average understandability score was 98.25% and 98% for the actionability of the videos. The higher the score, the more understandable and actionable the material is (Shoemaker et al. 2014). This finding supports the hypothesis of this research that the videos would have acceptable levels of understandability and actionability.

5.4 Think Aloud interview

Most respondents agreed that the videos were complete with information and easy to understand. From their opinions, videos can convey knowledge to prevent stunting problems among children. Research has proven that nutrition literacy is important in addressing knowledge deficits and continuously developing nutrition interventions (Silk et al., 2008).

The feedback from the respondents during the interview session indicates a generally positive reception of the videos, with a few areas for improvement. While most respondents enjoyed the videos, one person mentioned that they found them slow-paced, suggesting that increasing the speed might enhance engagement. This finding aligns with Wang and Antonenko (2017), who found that pacing in educational videos significantly affects learner engagement and retention. They recommended optimising video speed to maintain viewer interest without overwhelming them. The pace of the video should be carefully balanced to ensure optimal comprehension,

engagement, and retention of information. Based on established cognitive and multimedia learning theories, the moderate pace was crucial to maintaining understanding. A moderate pace ensures that the audience can process and absorb information effectively without feeling overwhelmed. According to the CLT, too much information presented too quickly can overload the learner's working memory, leading to poor retention

The respondents in this study appreciated the practical examples of food intake, which made the information easy to apply. Similarly, Al-Dubaib (2014) explained that health education videos that include practical examples and real-life scenarios enhance the effectiveness of the videos. Participants reported that relatable content helps bridge the gap between theoretical knowledge and practical application. However, confusion about calculating fat intake was noted. This is consistent with Partridge et al. (2015), who emphasised the need for clear and straightforward examples in dietary education to avoid misunderstandings and improve the applicability of the information provided.

Respondents mentioned environmental and economic obstacles to practising the knowledge, such as the abundance of unhealthy fast food and time and budget constraints. This is in line with Thomas and Irwin (2010), who highlighted that while educational videos can increase knowledge, real-world application is often hindered by socioeconomic factors. They suggested that addressing these barriers directly in the educational material can enhance the practical implementation of the advice given.

The positive feedback on infographics and animations in the videos aligns with findings by Mayer (2009), who showed that multimedia elements like infographics and animations significantly improve learning outcomes by catering to various learning styles and aiding in information retention. The suggestion to reduce text and increase visual content is supported by Ibrahim et al. (2012), who found that reducing cognitive load through visual aids and minimising textual information can enhance comprehension and retention in health education videos. On the other hand, the respondents desired additional

content on supplement intake and forbidden foods for pregnant mothers, as well as addressing technical glitches, as mirrored by Glanz et al. (2015). This study emphasised the importance of comprehensive content and technical quality in health education materials to ensure they are both informative and user-friendly. However, the videos and this study focus on maternal nutritional status in preventing childhood stunting only.

In summary, the development of these animated videos involved a detailed process incorporating cognitive load theory, cognitive frameworks, and a thorough understanding of the target audience. This careful planning has produced videos that effectively promote positive changes in knowledge, attitudes, and behaviours regarding nutrition.

5.5 Strengths and limitations

The development of the animated video promoting healthy nutrition intake among pregnant and exclusive breastfeeding mothers to prevent childhood stunting is a first of its kind. Using video as a nutrition education tool offers numerous advantages, including enhanced engagement through visually appealing content, easy accessibility across digital platforms, and the ability to simplify complex information through visual and auditory cues. Videos can reach a broad audience, including underserved populations, as they can be shared on social media and other online platforms, as aligned with the suggestion set by the WHO Global Strategy on Digital Health 2020-2025. This strategy emphasises the importance of digital tools in promoting health equity and facilitating the widespread dissemination of health information. Videos support this by providing scalable, cost-effective education that can improve understanding, inspire behaviour change, and ultimately enhance public health outcomes globally.

Secondly, the development and evaluation process were carried out following the DDR method, which is generally established for this purpose.

Using video as a nutrition education tool, coupled with the DDR method, offers numerous advantages. Videos enhance engagement by using visually appealing content that can simplify complex information, while the DDR method ensures the content is evidence-based and systematically developed. DDR provides a structured approach to creating educational tools involving content analysis, expert evaluations, and iterative design processes, leading to high- quality, effective materials. This combination ensures that the education tool is accessible, relevant, and impactful across diverse audiences, aligning with the WHO Global Strategy on Digital Health 2020-2025, which emphasises digital solutions to promote health equity and widespread dissemination of health information. Ultimately, videos produced using the DDR method can improve understanding, inspire behaviour change, and enhance public health outcomes globally. Furthermore, the videos underwent evaluation of the storyboards, scripts, and multimedia aspects by field experts, as well as evaluation by target populations in terms of their suitability, understandability and actionability.

The study was not without its limitations. For instance, since it was conducted during the COVID-19 pandemic, the recruitment of study participants was a bit slow. The study population had to be modified from pregnant and exclusively breastfeeding mothers to childbearing-aged women to improve participation. However, care was taken to ensure that each age group was equally represented.

Furthermore, due to the short duration of the videos (3-5 minutes), there might be limited opportunity to delve deeply into complex nutritional topics, potentially leading to oversimplification of critical concepts. This could result in gaps in knowledge or misinterpretations of dietary guidelines. Besides, the videos might not include interactive features that could enhance learning, such as quizzes, clickable links, or prompts for reflection. Interactive elements can significantly boost engagement and help consolidate learning. In addition, the evaluation of the videos can have been conducted over a short period, which does not capture long-term retention or behaviour change.

Longitudinal studies are needed to assess the sustained impact of the educational interventions.

By acknowledging these limitations, future studies can focus on improving the content, delivery, and evaluation methods of educational videos to make them more effective and inclusive. Addressing these areas can lead to a more comprehensive understanding of how video-based tools can be optimised for public health education.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

This study focused on developing and evaluating animated educational videos designed to promote healthy nutritional practices during pregnancy and exclusive breastfeeding to prevent childhood stunting. The evaluation assessed the videos' suitability, understandability, and actionability from the perspective of the respondents. The results indicated that the videos were generally suitable and acceptable, and they met the intended educational goals. Respondents found the videos engaging and informative. However, the evaluation also identified areas for improvement, including the need to enhance the scope of content, improve the presentation of lists, tables, and charts, refine captions used for graphics, and address issues related to typography and motivational aspects.

The findings highlight the effectiveness of animated videos in increasing awareness about childhood stunting and nutritional needs among pregnant and breastfeeding mothers. The videos serve as a valuable tool for disseminating crucial health information, potentially leading to better-informed decisions regarding dietary practices. Besides, addressing the identified areas for improvement can help the videos to be more impactful in educating mothers about the importance of meeting nutritional requirements. This video could contribute to reducing the incidence of childhood stunting and improving overall child health and development.

Health authorities and field experts are encouraged to conduct further interventions using animated videos to reach target populations more effectively. This includes refining video content based on user feedback and

incorporating interactive elements to enhance engagement. Furthermore, to maximise the impact of nutrition education, the videos should be updated to address the identified improvements. This involves expanding content scope, enhancing visual elements like tables and charts, and refining captions and typography to ensure clarity and effectiveness.

Besides, this study is alignment with the WHO Global Strategy on Digital Health 2020-2025 emphasises the importance of integrating digital tools into health education. The findings support the continued use and development of digital resources to improve public health outcomes.

Ongoing research is needed to assess the long-term impact of these educational videos on actual dietary practices and health outcomes. Longitudinal studies could provide insights into the effectiveness of the videos over time and inform future improvements. Besides, exploring other innovative methods, such as interactive video features or augmented reality, could further enhance the educational experience and engagement of the target audience.

In conclusion, while the developed animated videos demonstrate significant potential as educational tools for promoting healthy nutrition, addressing the identified areas for improvement and implementing strategic interventions can amplify their impact. This practice will contribute to better health outcomes and support global efforts to prevent childhood stunting.

6.2 RECOMMENDATIONS FOR FUTURE STUDIES

Based on the findings and limitations, the following recommendations for future research are made, such as longitudinal studies by assessing the long-term impact of the animated videos on dietary practices and health outcomes. In addition, to make the

video more interactive, integration of elements such as quizzes, prompts and user feedback options, which can boost engagement and reinforce learning, would make the educational experience more dynamic and effective. Besides, the study could be improved by conducting pre and post-knowledge, attitude and practice of the target populations towards the videos.

The newly developed animated videos can be can integrated with broader health campaigns and educational programs. For instance, coordinating with other health initiatives can enhance the reach and impact of the videos, ensuring that the nutritional information is part of a comprehensive approach to health education.

In summary, future research should focus on refining video content, expanding and diversifying the target audience, integrating interactive elements, and evaluating the videos' long-term impact and practical implementation. This approach will enhance the effectiveness of nutritional education and contribute to better health outcomes in preventing childhood stunting.

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APPENDIX A: Video script evaluation by experts

OBJECTIVES: Purposes, goals, or targets	0 (Disagree)	1 (Partially agree)	2 (Totally agree)
1. Contemplates the proposed theme Comments:			
2. Suits the teaching-learning process Comments:			
3. Clarifies doubts on the addressed theme Comments:			
4. Provides reflection on the theme Comments:			
STRUCTURE/PRESENTATION: Organization, structure, strategy, consistency, and sufficiency			
5. Language appropriate to the target audience Comments:			
6. Interactive language, enabling active involvement in the educational process Comments:			
7. Correct information Comments:			

8. Objective information Comments:			
9. Enlightening information Comments:			
10. Necessary information Comments:			
11. Logical sequence of ideas Comments:			
RELEVANCE: Significance, impact, motivation, and interest			
12. Encourages learning Comments:			
13. Contributes to knowledge in the area Comments:			
14. Arouses interest in the theme Comments:			

Figure 1: Video script evaluation by experts

PURPOSE
(2) -Purpose is explicitly stated in the title, cover illustration or introduction (1)-Purpose is not explicit, it is implied or multiple purposes
are stated. (0)-No purposed is stated in the title, illustration or
introduction.
CONTENT TOPICS

(2) -Majority of material is application of knowledge aimed at desirable reader behavior
(1)-At least 40% of content topics focus on desirable behavior or actions (0)-Nearly all topics focus on non behavior facts
SCOPE
(2) -Scope is limited to essential information directlyrelated too the purpose (1)-Scope is expanded beyond the purpose; no more than 40% is non essential information (0)-Scope is far out of proportion to the purpose and time allowed.
SUMMARY & REVIEW
(2) -Summaries are included and retell key message in different words or examples (1)-Some key topics are reviewed
(0)-No summary or review is included
5. WRITING STYLES
(2) - Conversational style and active voice are used throughout. Simple sentences are used extensively
(1)- About half the text uses conversational style and active voice. Less than half of sentence are complex with long phrases
(0) -Passive voice used throughout. Over half of sentences have long or multiple phrases
6. SENTENCE CONSTRUCTION
(2) -Consistently provides context before presenting new information (1)- Provides context first about half the time

(0)- Context is provided last or not at all
7. VOCABULARY
(2) - Common words are used all the time. Technical, category, value judgement words are explained, imagery words are used.
(1)- Common words are used frequently. Technical, category, value judgement words are explained sometimes. Some jargon or social math is used
(0)- Uncommon words are used frequently. No explanation or examples are given for technical, category, value jugdement words. Extensive jargon used.
8. TYPE OF GRAPHICS / ILLUSTRATION
(2) - Include both factors; Simple adult appropriate line drawings and illustrations are likely to be familiar to readers
(1)-One of the superior factors is
missing (0)- None of the superior
factors is present
9. RELEVENCE OF ILLUSTRATION
(2) -Illustration present key message visually so the reader can grasp the key ideas from illustration alone. No distractions.
(1)- Illustration include some distractions
(0)-Confusing illustration, no illustrations or an overload of illustrations
10. LISTS, TABLES, CHARTS, FORMS
(2)- Provide step by step directions with an example that will buildself

efficacy(confidence)

(1)- 'How to' directions are too brief for readers to understand and use the graphic without help

(0)- Graphics are presented without explanation

11. CAPTIONS USED FOR GRAPHIC

(2) - Explanatory captions with all or nearly all illustrations and graphic (1)- Brief captions are used for some graphics

(0)- Caption are not used

12. TYPOGRAPHY

(2)-At least three of the following four factors are present (1.Text type is in uppercase and lowercase readable font, 2.Type size is at least 12 point, 3. Typographic cues (bold, size, color)emphasize key points, 4. No ALL C

Ta ble 4: Mean score percentage for understandability, actionability and suitability (N=50)

APS for long headers or running text))

(1)- Two of the superior factors are present

(0)- One or none of the superior factors are present

13. DESIRED BEHAVIOR PATTERNS MODELED

(2) - Instruction model specific behavior and skills. Example; nutrition instructions emphasize changing eating patterns or cooking patterns

(1)- Information is mix of technical and common language the reader may not easily interpret in terms of daily living

(0)- Information is presented in nonspecific or category terms

such as food groups
14. MOTIVATION
(2) -Complex topics are subdivided into smaller parts so the reader may experience small successes in understanding or problem solving, leading to self-efficacy(confidence)) (1)-Some topics are subdivided to improve the reader's self efficacy (confidance) (0)-No partitioning is provided to create opportunities for small success
15. CULTURAL IMAGE AND EXAMPLES
(2) - Image and examples present culture in positive ways (1)- Neutral presentation of cultural images and foods
(0)- Negative images such as exaggerated or caricatured cultural characteristic, actions or examples

Figure 2 : Suitability Assessment of Materials (SAM)

APPENDIX B: Think Aloud Interview Questions

Questions

1. What are your overall views toward the video?
2. Was there anything you particularly disliked?
3. Was there anything you found particularly hard to practice?
4. Was there anything you particularly liked?
5. Was there anything you found particularly easy to practice?
6. Anything you wanted to see there/ expected to see there but didn't?
7. Do you have any suggestions for how the video could be improved?
8. Are there any other comments you would like to make?

Soalan

1. *Apakah pandangan kesuluruhan anda terhadap video ini?*
2. *Adakah terdapat Bahagian yang anda tidak suka?*
3. *Adakah terdapat Bahagian yang sukar diamalkan?*
4. *Adakah terdapat Bahagian yang anda gemari/ suka berkenaan video ini?*
5. *Adakah terdapat Bahagian yang mudah diamalkan?*
6. *Adakah terdapat Bahagian yang anda jangka ada dalam video ini tetapi tiada?*
7. *Adakah anda mempunyai cadangan bagaimana video dapat diperbaiki?*
8. *Adakah terdapat komen lain yang anda ingin katakan?*

APPENDIX C: Finalised script for videos

VIDEO 1:

Pengambilan Kalori dan Makronutrien semasa Kehamilan

Calorie and Macronutrient Requirement during Pregnancy

Tahukah anda? Masalah bantut dalam kalangan kanak-kanak didapati semakin meningkat di Malaysia? Kanak-kanak dikatakan mengalami masalah bantut apabila mempunyai ketinggian untuk umur dibawah 2 sisihan piawai berbanding ketinggian purata populasi kanak-kanak sebaya berdasarkan standard rujukan Pertubuhan Kesihatan Sedunia.

Did you know that stunting among children has been increasing in Malaysia? Based on the standard reference of the World Health Organization, children suffer from stunting when they have a height for age below 2 standard deviations as compared to the average height of the population among children of the same age.

Masalah bantut boleh mendatangkan banyak kesan negatif kepada kanak kanak, antaranya mengurangkan kecerdasan otak dan tahap IQ. Berdasarkan kajian, masalah bantut dalam kalangan kanak-kanak boleh disebabkan oleh kekurangan nutrisi yang dialami sewaktu masih di dalam kandungan ibu dan selepas dilahirkan. Kekurangan nutrisi terjadi apabila pengambilan kalori, makronutrien dan mikronutrien yang tidak mencukupi.

Stunting may cause multiple negative effects on children, including reducing brain intelligence and IQ levels. Based on research, stunting in children can be caused by nutrition deficiencies while still in the mother's womb and after birth. Nutrition deficiency occurs when the intake of calories, macronutrients and micronutrients are insufficient.

Video ini akan membincangkan tentang saranan pengambilan kalori dan makronutrien bagi ibu mengandung untuk mengelakkan masalah bantut dalam kalangan kanak-kanak. Wanita yang berusia 19 sehingga 59 tahun memerlukan keperluan kalori yang berbeza mengikut umur dan tahap aktiviti fizikal mereka. Berikut merupakan keperluan kalori bagi wanita yang tidak mengandung atau menyusukan bayi;

This video will discuss about the recommended calorie and macronutrients requirement for pregnant mothers to prevent stunting in children. Women aged 19 to 59 years need different caloric requirement according to their age and level of physical activity. The following are the calorie requirements for women who are not pregnant or breastfeeding;

	Keperluan Tenaga (kkal/hari) Energy Requirement (kcal/day)			
Usia Age	**Kurang Aktif Less Active**	**Sederhana Aktif Moderately Active**	**Aktif Active**	**Sangat Aktif Very Active**
19-29 tahun 19-29 years	1610	1840	2080	2310
30-59 tahun 30-59 years	1660	1900	2130	2370

Sumber: RNI (2017)

Source: RNI (2017)

Manakala, ibu yang mengandung memerlukan tambahan kalori untuk kekal sihat, aktif dan memastikan kesihatan dan tumbesaran janin yang baik. Berikut merupakan keperluan tambahan tenaga yang diperlukan semasa hamil mengikut trimester kehamilan:

Meanwhile, pregnant mothers need extra calories to stay healthy, active and ensure good health and healthy growth of the fetus. The following are the additional energy requirements needed during pregnancy according to the trimester of pregnancy:

Trimester	***Tenaga tambahan yang diperlukan semasa hamil*** **Extra energy needed during pregnancy**
Pertama First	*+ 80 kkal/hari* + 80 kcal/day
Kedua Second	*+ 280 kkal/hari* + 280 kcal/day
Ketiga Third	*+ 470 kkal/hari* + 470 kcal/day

Sumber: RNI (2017)
Source: RNI (2017)

Makronutrien terdiri daripada tiga kumpulan iaitu karbohidrat, protein dan lemak. Ketiga-tiga kumpulan ini adalah sumber kalori. Oleh itu, jumlah kalori yang diambil adalah berdasarkan jumlah makronutrient yang diambil. Berdasarkan keperluan zat bagi ibu hamil, konsep 'Suku-suku separuh' perlu sentiasa diamalkan untuk memenuhi keperluan harian ini kerana di setiap trimesterkehamilan janin memerlukan lebih nutrisi untukmembesar.

Macronutrients consist of three groups namely carbohydrates, proteins and fats. All three of these groups are sources of calories. Therefore, the amount of calories consumed is based on the amount of macronutrients consumed. Based on the nutrient needs for pregnant women, the concept of *'Suku-suku separuh'* should always be practiced to meet these daily needs because in each trimester of pregnancy the fetus needs more nutrition to grow.

Mari kita lihat kumpulan makronutrien pertama iaitu, KARBOHIDRAT. Pengambilan karbohidrat sangat penting sepanjang kehamilan. Ia merupakan sumber tenaga utama bagi mengelakkan ibu hamil kelesuan. Pengambilan karbohidrat yang mencukupi penting untuk memastikan peningkatan berat badan mengikut saranan sepanjang tempoh kehamilan dan menyokong perkembangan janin. Pengambilan 7 hidangan nasi/bijirin atau roti dan 2 hidangan buah setiap hari adalah dianggap mencukupi.

Let's look at the first group of macronutrients which is the CARBOHYDRATES.
Carbohydrate intake is very important during pregnancy. It is the main source of energy to prevent pregnant women from fatigue. Adequate carbohydrate intake is important to ensure recommended weight gain throughout pregnancy and support fetal development. Consuming 7 servings of rice/cereals or bread and 2 servings of fruit per day is considered sufficient.

Kumpulan kedua ialah PROTEIN. Di samping sumber kalori, protein berperanan dalam membantu perkembangan janin dalam pertumbuhan kulit, rambut, kuku dan otot. Malah, protein memainkan peranan besar dalam pembentukan sistem imunisasi janin. Wanita yang tidak mengandung atau menyusukan bayi memerlukan 52-53g protein setiap hari.

The second group is PROTEIN. In addition to being a source of calories, protein plays a role in helping the development of the fetus in the growth of skin, hair, nails and muscles. In fact, protein plays a big role in the formation of the fetus's immune system. Women who are not pregnant or breastfeeding need 52-53g of protein per day.

Bagi ibu hamil pula, keperluan protein harian bertambah mengikut trimester kehamilan. Berdasarkan sarananpengambilan zatmakanan

Malaysia, pada;

- *Trimester pertama: tambahan 0.5 g/ hari dari keperluan biasa*
- *Trimester kedua: tambahan 8 g/ hari*
- *Trimester ketiga: tambahan 25 g/ hari*

For pregnant women, the daily protein requirement increases according to the trimester of pregnancy. Based on the recommendation of Malaysian food intake, on;

- First trimester: additional 0.5 g/ day from the normal requirement
- Second trimester: additional 8 g/ day
- Third trimester: additional 25 g/ day

Satu lagi makronutrien yang diperlukan oleh ibu hamil ialah LEMAK. Lemak sihat memainkan peranan penting dalam perkembangan otak dan mata janin.

Bagi ibu yang mengandung, jumlah pengambilan lemak yang disarankan adalah berbeza mengikut trimester kandungan. Pada;

- *Trimester pertama: lemak yang diperlukan adalah sebanyak 54- 65 g/ hari*
- *Trimester kedua: 60-71 g/ hari*
- *Trimester ketiga: 65-78 g/ hari*

Another macronutrient that pregnant women need is FAT. Healthy fats play an important role in fetal brain and eye development. For pregnant mothers, the recommended amount of fat intake varies according to the trimester of pregnancy. On;

- First trimester: the required fat intake is 54-65 g/ day
- Second trimester: 60-71 g/ day
- Third trimester: 65-78 g/ day

Terdapat tiga jenis lemak yang berbeza iaitu lemak tepu, lemak tidak tepu dan lemak trans. Lemak yang baik terdiri daripada lemak mono tak tepu dan lemak poli tak tepu. Elakkan mengambil lemak trans seperti marjerin dan makanan terproses serta pastri, dan hadkan mengambil lemak tepu seperti makanan bergoreng dan makanan segerakerana ia merupakan sumber lemak yang tidak sihat. Ambil lemak tidak tepu secukupnya kerana ia lebih sihat. Antara contoh makanan yang mengandungi lemak tidak tepu adalah seperti kekacang, minyak sayuran, minyak zaitun dan lain-lain lagi.

There are three different types of fat which are saturated fat, unsaturated fat, and trans- fat. Good fats consist of monounsaturated fats and polyunsaturated fats. Avoid consuming trans fats such as margarine, processed foods and pastries, and limit intake of saturated fats such as fried foods and fast foods as they are sources of unhealthy fats. Consume enough unsaturated fats because they are healthier. Among the examples of foods that contain unsaturated fat are such as beans, vegetable oil, olive oil and others.

Kesimpulannya, pengambilan kalori dan makronutrien yang mencukupi dan mengikut saranan semasa hamil adalah penting. Ini bukan sahaja dapat memenuhi

keperluan ibu, malah dapat mengelakkan masalah bantut dalam kalangan kanak kanak.

In conclusion, adequate and recommended intake of calories and macronutrients during pregnancy is important. This can not only meet the needs of mothers, but can also prevent stunting in children.

VIDEO 2:

Pengambilan Kalori dan Makronutrien semasa Penyusuan Susu Ibu secara Eksklusif

Calorie and Macronutrient Requirement during Exclusive Breastfeeding

Tahukah anda? Wanita dewasa yang berusia 19 sehingga 59 tahun perlu mengambil jumlah kalori yang berbeza mengikut umur dan tahap aktiviti fizikal mereka. Berikut merupakan keperluan tenaga bagi wanita yang tidak mengandung atau menyusukan anak;

Did you know that adult women aged 19 to 59 years should consume different amounts of calories according to their age and level of physical activity. The following is the energy requirement for women who are not pregnant or breastfeeding;

	Keperluan Tenaga (kkal/hari) Energy Requirement (kcal/day)			
Usia Age	**Kurang Aktif Less Active**	**Sederhana Aktif Moderately Active**	**Aktif Active**	**Sangat Aktif Very Active**
19-29 tahun 19-29 years	1610	1840	2080	2310
30-59 tahun 30-59 years	1660	1900	2130	2370

Sumber: RNI, 2017

Source: RNI, 2017

Selanjutnya, video ini akan memberi fokus tentang pengambilan kalori dan makronutrien yang mencukupi bagi ibu semasa penyusuan secara ekslusif. Ini membantu bayi mendapat kalori yang mencukupi dan seterusnya dapat mengelakkan masalah bantut dalam kalangan kanak-kanak. Bayi harus diberikan susu ibu secara eksklusif untuk enam bulan pertama sebaik saja dilahirkan sejajar dengan saranan Pertubuhan Kesihatan Sedunia.

Furthermore, this video will focus on consuming sufficient calories and macronutrients for mothers during exclusive breastfeeding. This helps the baby get sufficient calories and avoid stunting in childhood. Infants should be exclusively breastfed for the first six months as soon as they are born in line with the World Health Organization recommendations.

Jumlah keperluan kalori harian semasa tempoh penyusuan adalah berbeza berbanding wanita biasa dan sewaktu mengandung. Misalnya, pertambahan kalori sebanyak +500 kkal/hari berbanding wanita tidak menyusu diperlukan agar keperluan nutrisi ibu menyusu adalah mencukupi. Penambahan kalori ini boleh dicapai dengan memanfaatkan waktu makan pagi, minum petang dan makan lewat malam dalam jadual makan seharian bagi mendapatkan kalori tambahan. Sebagai contoh, tambahan 'sandwich telur' pada waktu minum pagi, tauhu sumbat pada minum petang dan segelas susu sebelum tidur boleh diambil agar kalori tambahan yang diperlukan seharian dapat dicapai.

The total of daily calorie needs during the breastfeeding period is different as compared to normal women and during pregnancy. For example, an increase in calories of +500 kcal/day as compared to a non-breastfeeding woman is required to meet the nutritional needs of a nursing mother. This additional calorie can be achieved by utilizing morning snack, evening snack and supper

in the daily meal schedule to get additional calories. For example, you can take an additional 'egg sandwich' at the time of the morning snack, *'tauhu sumbat'* during the evening snack and a glass of milk before going to bed so that the additional calories needed throughout the day can be achieved.

Pengambilan karbohidrat sangat penting sepanjang menyusu. Ia merupakan sumber tenaga utama bagi mengelakkan ibu menyusu kelesuan. Pengambilan karbohidrat yang mencukupi penting untuk memastikan peningkatan berat badan mengikut saranan sepanjang tempoh kehamilan dan menyokong perkembangan janin. Pengambilan 50-65% karbohidrat dari Jumlah kalori dianggap mencukupi semasa menyusukan anak.

Carbohydrate intake is very important throughout breastfeeding. It is the main source of energy to prevent lethargic nursing mothers. Adequate intake of carbohydrates is important to ensure weight gain according to recommendations throughout the gestation period and support the development of the fetus. Intake of 50-65% carbohydrates from the number of calories is considered sufficient when breastfeeding a child.

Bagi keperluan makronutrien lain pula, pertambahan sebanyak 19g protein setiap hari pada 6 bulan pertama selepas bersalin dikira mencukupi bagi ibu yang menyusu. Jumlah ini adalah bersamaan dengan pengambilan pertambahan 1 gelas susu
+ 1 biji telur ayam dari keperluan protein seharian. Protein yang mencukupi penting bagi membantu proses pemulihan kesihatan ibu selepas bersalin dan menyokong penghasilan susu ibu.

For other macronutrient needs, an increase of 19g of protein per day in the first 6 months after delivery is considered sufficient for breastfeeding mothers. This amount is the same as taking the addition of 1 glass of milk + 1 chicken egg from the daily protein requirement. Adequate protein is important to help the

mother's health recovery process after giving birth and support the production of the mother's milk.

Untuk keperluan lemak, sepanjang 6 bulan pertama penyusuan susu ibu secara eksklusif, sebanyak 66-79 gram lemak diperlukan dalam diet seharian. Pemilihan lemak yang sihat sangat penting bagi mengelakkan penyakit kronik yang tidak diingini seperti darah tinggi, strok dan serangan jantung. Pengambilan lemak yang mencukupi penting bagi memastikan para ibu mendapat tenaga yang mencukupi sepanjang tempoh menyusukan anak dan menyokong penghasilan susu ibu.

For fat intake, during the first 6 months of exclusive breastfeeding, as much as 66-79 grams of fat is needed in the daily diet. Selection of healthy fats is very important to prevent unwanted chronic diseases such as high blood pressure, stroke, and heart attack.

Adequate fat intake is important to ensure mothers get sufficient energy throughout the breastfeeding period and to support mother's milk production.

Lemak yang baik terdiri daripada lemak mono tak tepu dan lemak poli tak tepu. Sebagai contoh,anda boleh meletakkan beberapa titis minyak zaitun ke atas salad sayur-sayuran atau ulam-ulaman sebagai pelengkap hidangan dari sumber lemak yang baik. Hadkan pengambilan lemak tepu dan elakkan pengambilan lemak trans dalam hidangan seperti makanan terproses, pastri dan makanan segera.

Good fats consist of monounsaturated fats and polyunsaturated fats. For example, you can put a few drops of olive oil on a vegetable salad or *'ulam-ulaman'* to complement the meal of good fat sources. Limit intake of saturated fats and avoid intake of trans fats in foods such as processed foods, pastries and fast foods.

Pengambilan tenaga dan makronutrien iaitu karbohidrat, protein dan lemak, yang mencukupi sepanjang tempoh menyusu anak perlu dititikberatkan dan diamalkan agar ibu sentiasa sihat dan pemberian susu ibu secara eksklusif kepada bayi lebih berkualiti dan dapat dijayakan. Ini membolehkan bayi mendapat tenaga yang diperlukan untuk membesar dengan sihat dan mencegah dari masalah bantut.

Energy and macronutrients intake, namely carbohydrates, protein and fat, which are sufficient throughout the period of breastfeeding a child needs to be emphasized and practiced so that mothers are always healthy and the exclusive mother's milk to babies are of higher quality and can be achieved successfully. This allows the baby to get the energy it needs for healthy growth and prevent stunting.

VIDEO 3:

Keperluan vitamin semasa Kehamilan dan Penyusuan Susu Ibu Secara Eksklusif Vitamin requirements during Pregnancy and Exclusive Breastfeeding

Mikronutrien terdiri dari kumpulan vitamin dan mineral. Ia hanya diperlukan dalam kuantiti yang kecil dalam pemakanan seharian kita, namun demikian ia memainkan peranan yang besar dalam menjamin kesihatan ibu hamil dan menyusu dan juga perkembangan bayi sewaktu dalam rahim dan selepas kelahiran. Pastikan anda menonton video ini sehingga akhir untuk mengetahui lebih lanjut, apakah vitamin yang perlu diberi perhatian, fungsi-fungsinya dan implikasi sekiranya pengambilan tidak mencukupi atau berlebihan. Terdapat 13 vitamin yang diperlukan oleh tubuh manusia. Walau bagaimanapun, video ini hanya akan memberi fokus tentang pengambilan 4 vitamin yang diperlukan untuk kesihatan ibu dan bayi yang optima.

Micronutrients consist of a group of vitamins and minerals. It is only needed in small quantities in our daily diet, however it plays a big role in ensuring the health of pregnant and lactating mothers and also the development of the baby during in the womb and after birth. Make sure you watch this video until the end to learn more, what vitamins should be emphasized, their functions and the implications if the intake is insufficient or excessive. There are 13 vitamins needed by the human body. However, this video will only focus on the intake of 4 vitamins that are necessary for optimal health of mother and baby.

Pertama, vitamin A bukan sahaja penting untuk kesihatan mata malah membantu pertumbuhanjanin dan mempercepat penyembuhan luka pada kulit terutamanya selepas ibu melahirkan anak. Ibu mengandung memerlukan 800 mcg vitamin A manakala selepas melahirkan anak, ibu

perlu tambahan 50 mcg vitamin A. Sumber makanan yang kaya dengan vitamin A seperti lobak merah, hati, susu dan telur. Sekiranya pengambilan vitamin A tidak mencukupi dikhuatiri janin tidak dapat membesar secara optimum. Walau bagaimanapun, ibu perlu berhati-hati agar tidak mengambil vitamin A secara berlebihan

kerana dikhuatiri akan memberi kesan seperti toksik kepada hati dan kecacatan kepada bayi.

First, vitamin A is not only important for eye health but also helps the growth of the fetus and accelerates the healing of wounds on the skin, especially after the mother gives birth. Pregnant mothers need 800 mcg of vitamin A while after giving birth, mothers need an additional 50 mcg of vitamin A. Food sources rich in vitamin A such as carrots, liver, milk and eggs. If the intake of vitamin A is insufficient, it is feared that the fetus will not be able to grow optimally. However, mothers need to be careful not to take vitamin A excessively because it is feared that it will have effects such as toxicity to the liver and defects to the baby.

Selain itu, Vitamin B juga penting bagi ibu yang hamil. Pengambilan vitamin B yang mencukupi dapat mengelakkan kecacatan janin dan kekejangan otot para ibu. Vitamin B boleh didapati dari sumber hati, daging tanpa lemak, ikan dan susu. Berikut merupakan keperluan Vitamin B yang diperlukan bagi ibu hamil dan menyusukan anak:

In addition, Vitamin B is also important for pregnant mothers. Adequate intake of vitamin B can prevent fetal defects and muscle spasms in mothers. B vitamins can be found in liver, lean meat, fish and milk. The following are the Vitamin B requirements for pregnant and breastfeeding mothers:

Vitamin	**Hamil** **Pregnant**	**Menyusu** **Breastfeeding**
Tiamin, B1 (mg) *Thiamin, B1 (mg)*	1.4	1.5
Riboflavin, B2 (mg) *Riboflavin, B2 (mg)*	1.4	1.6
Asid Pantotenik, B5 (mg) *Pantothenic acid, B5 (mg)*	100	100
Piridoksin, B6 (mg) *Pyridoxine, B6 (mg)*	18	17
Asid folik, B9 (mcg) *Folic acid, B9 (mcg)*	600	500

Sumber: Panduan Penyusuan Susu Ibu, Kementerian Kesihatan Malaysia (2019)

Source: Breastfeeding Mother's Guide, Ministry of Health Malaysia (2019)

Seterusnya, asid folik ialah sejenis vitamin B yang diperlukan oleh para ibu mengandung dan menyusukan anak. Ibu yang mengandung memerlukan sebanyak 600ug asid folik manakala ibu yang menyusu pada 6 bulan pertama memerlukan hanya 500ug setiap hari. Ia penting bagi mengelakkan kecacatan bayi sepeti kecacatan tiub saraf dan membantu penghasilan sel baru setiap hari. Makanan yang kaya dengan sumber asid folik ialah sayuran hijau, kekacang dan makanan yang diperkaya dengan asid folik.

Next, folic acid is a type of vitamin B that is needed by pregnant and breastfeeding mothers. Pregnant mothers need 600ug of folic acid while breastfeeding mothers in the first 6 months need only 500ug per day. It is important to prevent the baby's defects such as neural tube defects and help the production of new cells every day. Foods rich in folic acid sources are green leafy vegetables, legumes and foods fortified with folic acid.

Vitamin C juga penting semasa mengandung dan menyusukan bayi. Vitamin C membantu melindungi sel tubuh, membentuk penghasilan kolagen di tulang, otot, kulit, serta salur darah. Bukan itu sahaja, vitamin C juga penting untuk merawat luka terutama selepas melahirkan anak. Keperluan vitamin C semasa mengandung ialah 80mg manakala keperluan semasa tempoh 6 bulan menyusu secara eksklusif ialah 95mg. Sumber makanan yang mudah didapati yang mengandungi tinggi vitamin C seperti jambu batu, limau, dan betik, perlu diambil oleh ibu yang baru melahirkan anak bagi mengelakkan luka lambat sembuh.

Vitamin C is also important during pregnancy and breastfeeding. Vitamin C helps protect body cells, forming collagen production in bones, muscles, skin, and blood vessels. Not only that, vitamin C is also important to treat wounds, especially after giving birth. The requirement of vitamin C during pregnancy is 80mg while the requirement during 6 months of exclusive breastfeeding is 95mg. Food sources that are easily available containing high levels of vitamin C such as guava, lemon, and papaya should be taken by mothers who have just given birth to avoid slow healing wounds.

Pengambilan vitamin D pula dapat membantu mengekalkan tahap kalsium dan fosforus di dalam badan ibu. Ini penting untuk mengekalkan kekuatan tulang dan gigi yang optimum. Ibu mengandung dan menyusu anak memerlukan sebanyak 15ug vitamin D setiap hari. Sumber makanan yang kaya dengan vitamin D ialah, ikan sardin, telur, daging dan ikan mackerel. Pendedahan pada matahari juga sangat membantu para ibu mendapat vitamin D yang mencukupi setiap hari.

Taking vitamin D can help maintain calcium and phosphorus levels in the mother's body. This is important to maintain optimal bone and teeth strength. Pregnant and breastfeeding mother’s 15ug of vitamin D per day. Food sources rich in vitamin D are sardines, eggs, meat and mackerel. Exposure to the sun also helps mothers get enough vitamin D every day.

Oleh itu, amatlah penting untuk ibu yang mengandung dan menyusu untuk menitik beratkan sumber makanan yang kaya vitamin A, B, C, D bagi mengekalkan kesihatan yang baik untuk ibu dan anak.

Therefore, it is very important for pregnant and lactating mothers to focus on food sources rich in vitamins A, B, C, D to maintain good health for mother and child.

VIDEO 4:

Keperluan mineral semasa Kehamilan dan Penyusuan Susu Ibu Secara Eksklusif

Mineral requirements during pregnancy and exclusive breastfeeding

Berdasarkan Malaysian Recommended Nutrient Intakes (2017), terdapat 14 mineral yang diperlukan oleh tubuh manusia. Walaubagaimanapun, video ini hanya akan memberi fokus tentang pengambilan tiga mineral yang diperlukan untuk kesihatan ibu dan bayi yang optimum. Tiga mineral penting yang akan diberi perhatian di dalam video ini iaitu zat besi, kalsium dan iodin.

Based on the Malaysian Recommended Nutrient Intakes (2017), there are 14 minerals required by the human body. However, this video will only focus on the intake of three minerals that are necessary for the optimal health of mother and baby. The three important minerals that will be highlighted in this video are iron, calcium and iodine.

Keperluan mineral meningkat semasa tempoh kehamilan dan penyusuan susu ibu secara eksklusif. Zat besi diperlukan oleh ibu mengandung sebanyak 30- 60mg untuk mengelakkan masalah anemia manakala ibu menyusukan anak memerlukan sebanyak 20-29mg untuk menggantikan darah yang hilang selepas bersalin. Contoh makanan yang kaya dengan zat besi ialah hati, daging tanpa lemak, kuning telur, kekacang (seperti kacang kuda dan kacang pea) dan buah buahan kering (kismis dan kurma) serta makanan yang difortifikasi dengan zat besi (roti dan bijirin sarapan pagi yang diperkaya).

Mineral requirements increase during pregnancy and exclusive breastfeeding. Pregnant mothers need 30-60mg of iron to avoid anemia while breastfeeding mothers need 20-29mg of iron in order to replace the blood lost after giving birth. Examples of iron-rich foods are liver, lean meats, egg yolks, legumes (such as chickpeas and peas) and dried fruits (raisins and dates) as well as iron- fortified foods (iron-fortified bread and

breakfast cereals).

Bagi keperluan kalsium pula, ibu yang mengandung dan menyusu memerlukan

1,000 mg setiap hari untuk pembentukan tulang dan gigi bayi terutamanya pada trimester ketiga. Ia juga membantu mengelakkan kekejangan otot pada ibu yang mengandung. Keperluan ini adalah 200mg lebih tinggi berbanding wanita yang tidak hamil dan menyusukan bayi. Contoh makanan yang tinggi dengan sumber kalsium seperti susu dan produk tenusu, ikan bilis, ikan sardin, kekacang, dan sayuran hijau. Ibu disarankan untuk meminum 2 gelas susu setiap hari bagi melengkapkan keperluan kalsium setiap hari.

As for calcium requirements, pregnant and lactating mothers need 1000mg per day for the formation of the baby's bones and teeth, especially in the third trimester. It also helps prevent muscle spasms in pregnant women. This requirement is 200mg higher than for women who are not pregnant and breastfeeding. Examples of foods high in calcium are milk and dairy products, anchovies, sardines, beans, and green leafy vegetables. Mothers are advised to drink 2 glasses of milk every day to complete the daily calcium requirement.

Seterusnya, pengambilan iodin juga penting untuk ibu hamil dan menyusu. Ibu yang hamil akan lebih kerap membuang air kecil yang akan mengakibatkan kandungan iodin di dalam badan turut hilang. Bagi mengelakkan kekurangan iodin yang boleh menyebabkan masalah hipotiroid, ibu mengandung dan menyusu memerlukan sebanyak 200ug setiap hari. Makanan yang kaya dengan iodin seperti makanan laut (ikan bilis, kerang dan kepah), garam beriodin, susu dan produk tenusu (keju dan yogurt).

Next, iodine intake is also important for pregnant and lactating mothers. Pregnant mothers will urinate more often which will result in the loss of iodine content in the body. To avoid iodine deficiency that can cause hypothyroid, pregnant and lactating mothers will need as much as 200ug per day. Foods rich in iodine such as seafood (anchovies, clams and scallops), iodized salt, milk and dairy products (cheese and yoghurt).

Kesimpulannya, bukan sahaja sumber kalori, makronutrien dan vitamin yang penting semasa mengandung dan meyusukan bayi, sumber mineral juga perlu diambil dengan mencukupi dengan pelbagaikan sumber makanan agar kesihatan ibu dan bayi lebih terjamin.

In conclusion, not only are the sources of calories, macronutrients, and vitamins, important during pregnancy and breastfeeding, mineral sources are also needed to be taken sufficiently by diversifying food sources so that the health of the mother and baby is more guaranteed.

APPENDIX D : Responses for think Aloud interview (N=10)

Table 4.11 Responses for Think Aloud interview (N=10)

Questions	Responses
1. What are your overall views toward the video? *Apakah pandangan kesuluruhan anda terhadap video ini?*	• Ok, actually, for me, these videos are interesting because has infographics and informative • Ok, easy to understand, lots can be learned. • I think this video already gives complete information on the food intake of pregnant and breastfeeding mother • In my opinion, this video really helps in conveying information to prevent stunting problems among children. Especially this problem can be prevented during pregnancy • *Secara keseluruhannya, video-video yang dipaparkan adalah ringkas tetapi padat dengan informasi yang sangat berguna kepada ibu yang sedang hamil atau ibu yang sedang menyusu. Bahasa dan tulisan yang ada*

	di dalam video-video ini juga mudah difahami dengan mudah. Suara latar penulis juga lembut dan tidak menyakitkan telinga para penonton, menyebabkan para penonton menjadi tertarik untuk mendengar dengan lebih lanjut. Amat sesuai jika digunakan dan dipamerkan video-video ini untuk tujuan pelajaran di klinik ibu dan anak (sementara menunggu nombor giliran dipanggil). • In my opinion, this video is simple to understand. For someone who has no basic (nutrition knowledge), but still can understand • For me, good, informative, and interactive • Satisfying • Just nice, good videos • *Video lengkap dan bermanfaat untuk ibu hamil dan menyusu*
2. Was there anything you particularly disliked? *Adakah terdapat bahagian yang anda tidak suka?*	• I think there is not of it, except, for me, a quiet, slow pace, maybe easier for others to catch up • So far, everything is ok • Hmm, no • Easy to understand • *Tiada* • So far, no. All videos are interesting • Nothing, all good • Nothing, clear videos • Nothing • *Tiada*
3. Was there anything you found particularly hard to practice?	• Urm, no, because everything already included with examples • Basically it is normal routine for women. Therefore, it is easy to follow and practice

Adakah terdapat bahagian yang sukar diamalkan?	• Part where need to calculate fat intake, quite confusing to calculate • For me, difficult part to practice is about fast-food intake where most of the viral food are unhealthy and reachable. But insyaallah can overcome this problem • *Kemungkinan dari segi konsistensi untuk mengamalkan pengambilan makanan yang cukup nutrien, mineral, dan vitamin setiap hari disebabkan oleh beberapa faktor luaran. Contohnya, ibu tidak sempat menyediakan makanan yang cukup nutrien, mineral, dan vitamin untuk diri sendiri atau makanan yang dijual di kedai makan mahal (menyebabkan ibu berkira-kira untuk mengambil lauk-pauk cukup nutrisi).* • All parts of the video are easy to practice. There is no part that difficult • No • No • No • *Tiada, mudah untuk difahami*
4. Was there anything you particularly liked? *Adakah terdapat bahagian yang anda gemari/ suka berkenaan video ini?*	• This video the part that I like is nice infographic and picture • Easy to follow • Nice animation, interesting to watch • The part that I like most in this video is about the quarter half, for example, this concept when we practice daily will get enough nutrition for our body • *Saya suka bahagian keperluan tenaga yang diperlukan semasa mengandung atau menyusu anak. Dari bahagian itu kita boleh tahu berapa tenaga yang diperlukan mengikut trimester kehamilan, selepas hamil, dan ketika menyusukan anak.*

	• For me, the videos are really simple and easy to understand, then the animations also easy to understand • For me, *suku suku separuh* • Really like it because clear explanation • For me, clear animation and infographic • *Infografik yang menarik*
5. Was there anything you found particularly easy to practice? *Adakah terdapat bahagian yang mudah diamalkan?*	• Yes, for example suggestion of food intakes • Part that easy to practice like rice intake and nutritious foods • Concept of quarter quarter half easy to practice • Quarter quarter half concept easy to practice • *Jumlah makanan yang perlu disediakan mengikut saranan didalam video seperti berapa sajian ikan atau ayam yang perlu diambil untuk menghasilkan susu yang mencukupi kepada anak.* • All are easy to practice, especially on vitamins part • All easy • Everything complete • Yes, it is. *Suku suku separuh* easy to practice • *Pengambilan mineral semasa penyusuan dan kehamilan mudah diamalkan kerana suplemen seperti iodin dan iron boleh didapatkan di kedai2 kesihatan dan farmasi. Mineral ini sangat penting untuk ibu hamil untuk memberi tenaga yang optimum dan mengelakkan sebarang perkara tidak diingini demi kesihatan ibu dan anak.*
6. Anything you wanted to see there/ expected to see there but didn't?	• I am not sure about this video are intent for real food only or others. I think, maybe should include information on supplement intake of pregnant mother • I think everything already include inside the videos • ermm… Forbidden food for pregnant mother

Adakah terdapat Bahagian yang anda jangka ada dalam video ini tetapi tiada	• From my expectation, this video to avoid stunting problem since in pregnancy. If the children are alreasdy stunted, what food that need to take by them • *Tiada* • No • For me, examples of food intake during pregnancy that need to be avoided • No • No • *Tiada contoh untuk perkara jika kekurangan zat*
7. Do you have any suggestions for how the video could be improved? *Adakah anda mempunyai cadangan bagaimana video dapat diperbaiki?*	• No • I think it is alreary ok and no need to add on anything • Ok, just nice • No • No • I think, no, these videos are good • For this video, in my suggestions is, to reduce writing/words and numbering and increase infographic • No • No • *Untuk informasi tentang pengambilan zat yang cukup sudah baik, tetapi mungkin boleh menambahbaik dengan contoh2 perkara yang akan berlaku jika kekurangan zat2 tersebut. Mungkin boleh letakkan potongan akhbar dan penilitian dari sumber ilmiah*
8. Are there any other comments you would like to make? *Adakah terdapat komen lain yang anda ingin utarakan?*	• I think there is a slight glitch in the video on the part of saturated fat and unsaturated fat • No • No • I think this video can help pregnant mothers achieve complete nutrition • no

	• Urm, no. • For me, this kind of video needs to be broadcast at the clinic as a reference for pregnant mothers • No • No • *Tiada*

APPENDIX E: Finalised video

Finalised videos

Scan to watch the videos

APPENDIX F: RESEARCH MANAGEMENT CENTRE (RMC)

Our Reference: IIUM/504/14/11/2/IREC2021-062 Date : 19 July 2022

Asst. Prof. Dr. Nor Azwani binti Mohd Shukri Kulliyyah of Allied Health Sciences
IIUM Kuantan Campus25200 Kuantan Pahang

Dear Asst. Prof. Dr.,

IREC ID	:	**IREC 2021-062**
Title	:	**Development and validation of educational animated video series promoting healthy nutritional management during pregnancy towards prevention of child stunting**

:

Co-Investigator

1. Asst. Prof. Dr. Muhamad Ashraf bin Rostam (Department of Nutrition Sciences, Kulliyyah of Allied Health Sciences, IIUM)

2. Asst. Prof. Dr. Muhamad Sadry bin Abu Seman (Department of Information Systems, Kulliyyah of Information & Communication Technology, IIUM)

3) Dr. Rahiwan Nazar bin Romli (Faculty of Computing, College of Computing & Applied Sciences Universiti Malaysia Pahang (UMP)

4) Mohd Ramadan bin Ab. Hamid (Senior Lecturer, Centre of Nutrition & Dietetics, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM)

Approval Date : **19 Jul 2022**

Ethical Expiry Date : **19 Jul 2023**

APPROVAL LETTER OF CONTINUING REVIEW APPLICATION

We would like to inform you that the **IIUM Research Ethics Committee (IREC)** received the Continuing Review Application Form on **07 Jul 2022.** Upon review of the Continuing Review Application Form, the IREC committee **APPROVED** yo

application to continue the aforementioned study for another one (1) year.

The investigator(s) are required to submit the:

a) Progress Report Form on every six (6) month from the date of approval.
b) End of Project Report Form to the IREC Secretariat's Office once the study was completed. You may download the form from website at www.iium.edu.my/centre/irec

Thank you for your continuing compliance with the requirements of the IREC.

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Yours sincerely,

PROF. DR. NASSER MUHAMMAD AMJAD

Chairman,
IIUM Research Ethics Committee (IREC)

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