KNOWLEDGE, ATTITUDE, AND PRACTICE TOWARDS

PROBIOTICS FOR THE GUT-SKIN AXIS AMONG

HEALTH SCIENCE STUDENTS IN HEALTH CAMPUS

UNIVERSITI SAINS MALAYSIA, KUBANG KERIAN,

KELANTAN

by

NUR IZYAN IKHWANI BINTI MAHFUZ

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DECLARATION

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

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Nur Izyan Ikhwani Binti Mahfuz

Date: 1st July

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ABSTRAK

Meskipun terdapat bukti saintifik yang semakin berkembang mengenai potensi probiotik dalam mempengaruhi kesihatan usus dan kulit, kajian berkaitan pengetahuan, sikap dan amalan terhadap isu ini masih terhad. Pelajar Sains Kesihatan, sebagai bakal profesional kesihatan, dijangka mempunyai tahap pengetahuan, sikap dan amalan yang baik terhadap penggunaan probiotik untuk paksi usus-kulit. Oleh itu, kajian ini dijalankan bagi menilai hubungan antara pengetahuan, sikap dan amalan probiotik dengan faktor sosiodemografi dalam kalangan pelajar Sains Kesihatan di USM, Kampus Kesihatan Kubang Kerian, Kelantan. Kajian keratan rentas ini dijalankan dalam kalangan pelajar diploma dan prasiswazah menggunakan kaedah 'convenience sampling'. Data diperoleh melalui soal selidik atas talian (Google Form) yang diedarkan melalui kumpulan WhatsApp. Analisis data dilakukan menggunakan SPSS versi 29 dan ujian 'Pearson chi-square' digunakan dengan aras signifikan ditetapkan pada $p < 0.05$. Daripada 193 responden, majoriti menunjukkan tahap pengetahuan yang lemah, sikap yang sederhana, manakala tahap amalan juga adalah rendah. Tahap pendidikan menunjukkan hubungan yang signifikan terhadap sikap ($p = 0.046$) dan amalan ($p = 0.035$). Terdapat juga hubungan signifikan antara kawasan demografi tempat tinggal dengan sikap ($p = 0.021$). Walau bagaimanapun, tiada faktor sosiodemografi yang menunjukkan hubungan signifikan dengan pengetahuan. Sikap berkait rapat dengan tahap pendidikan dan kawasan demografi, manakala amalan hanya berkait dengan tahap pendidikan. Hasil kajian membuktikan wujud jurang antara pengetahuan, sikap dan pratikal sebenar dalam kehidupan harian. Isu ini menunjukkan keperluan program pendidikan yang lebih berfokus untuk meningkatkan pengetahuan serta mendorong amalan penggunaan probiotik yang lebih baik bagi kesihatan usus dan kulit.

ABSTRACT

Studies on Health science students regarding knowledge, attitude, and practice (KAP) of probiotics for the gut-skin axis remain under exploration, as they are expected to have higher KAP on these issues. Thus, this study aims to observe the extent of KAP results among the students of Health Science in USM, Kubang Kerian, Kelantan, and determine the association with their sociodemographic factors. A cross-sectional study was utilized using a convenience sampling method. Respondents' data were obtained using an online questionnaire via a Google Form that was distributed through a few WhatsApp groups. Pearson's chi-square test was used for statistical significance of association at $p < 0.05$ using SPSS *version 29*. Among 193 respondents, the majority possessed poor knowledge, moderate attitudes, and poor practice. Educational level was strongly associated with attitudes ($p = 0.046$) and practices ($p = 0.035$). A statistically significant association was detected between hometown demographic area and attitude ($p = 0.021$). Overall, no sociodemographic variables showed a significant association with knowledge. Attitudes were significantly associated with educational level and demographic area. Practice was merely significantly associated with educational level. The outcome suggested a disconnect between their understanding and actual behaviors. These results highlight the need for well-coordinated educational programs aimed at enhancing knowledge and affecting the application of probiotics for gut-skin health.

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CHAPTER 1: INTRODUCTION

1.1 STUDY BACKGROUND

The International Scientific Association for Probiotics and Prebiotics described probiotics as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host" (Hill et al., 2014). The production of probiotics-based dietary products has increased due to their therapeutic effects on health (Shireen & Savanur, 2024). In addition, there is also an increasing trend of skin condition enhancement related to the utilization of probiotics, known as the gut-skin axis (Ong et al., 2023). Nevertheless, modern food practices commonly exclude these functional foods essential in nourishing gut microbiota (Shireen & Savannur, 2024). However, current findings proved that even unalive cells, including damaged or extracted cells and metabolites from probiotics, are still able to deliver health benefits to humans (Lena et al., 2015).

Probiotics benefit both skin condition improvement and treatment by enhancing the digestive system and strengthening immune function. This is because probiotics can naturally lower inflammation and diversify the gut microbiota. A stable microbiome in the gut will help to maintain a strong immune system through adequate anti-microbial peptides, which leads to healthy skin conditions. Human body immunity is influenced by beneficial bacteria in the gut. Various diseases related to allergies, infections, and issues in digestion, including skin disorders such as rosacea, eczema, and psoriasis, are related to dysbiosis in the gut (Stergios, 2024).

Skin is the largest organ in the human body, with approximately 25 m2, and is associated with the microbiome for immune function (Gallo, 2017). It is a primary barrier to harmful surroundings, including invading pathogens (De Pessemier et al., 2021). The gut-skin axis analogy was discovered from the gut and skin interrelation through nerves and blood vessels (O'Neill et al., 2016). Acne, atopic dermatitis, psoriasis, and dandruff, including skin cancer, are examples of skin conditions that are believed to be strongly linked to dysbiosis of the skin as well as the gut microbiome, which has been associated with altered immunity (De Pessemier et al., 2021).

Wu et al. (2020) also stated that a lack of adequate nutritious food and exposure to chemicals, ingredients, and other environmental factors have contributed to dysbiosis and microbe-derived metabolic classes in diverse human diseases. There are still limited number of studies in Malaysia investigating the knowledge, attitudes, and practices of probiotics for the gut-skin axis. Hence, the purpose of this research is to investigate the knowledge, attitudes, and practices of probiotics towards the gut-skin axis among health science students in Universiti Sains Malaysia (USM).

1.2 PROBLEM STATEMENT

Despite the emerging research on probiotics related to the gut-skin axis, the general public still relies solely on topical skincare products such as serum and essence to manage their skin problems and often overlooks the importance of gut health, particularly in maintaining microbiome balance, which also could influence their skin condition. In Malaysia, knowledge, attitudes, and practices of probiotics related to the gut-skin axis are still under insufficient investigation. Although many consumers are starting to be well aware and knowledgeable regarding probiotics, proper attitudes and practices towards this functional food are still categorized as poor, especially for gut and skin health (Ong et al., 2023). According to Arshard et al. (202), the correct application of probiotics is still lacking among the public, even though the term is widely known nowadays. This matter may result in misuse or a lack of utilization of these dietary components. It thus may impact individuals' health (Sharma et al., 2019).

In addition, specific studies focusing on the KAP of probiotics in relation to the gut-skin axis within local settings, such as Kubang Kerian, Kelantan, are notably limited. This gap in the literature highlights the need for further research to understand the sociodemographic factors that may influence the KAP of probiotics in this population. Addressing this gap could help inform future health promotion efforts and contribute to better utilisation of probiotics for improving both gut and skin health.

1.3 RESEARCH QUESTION

Is there any association between knowledge, attitude, and practice towards probiotics for the gut-skin axis with sociodemographic factors among School of Health Sciences students at USM, Kubang Kerian, Kelantan?

1.4 RESEARCH OBJECTIVES

1.4.1 GENERAL OBJECTIVE:

To determine the association between knowledge, attitudes, and practice towards probiotics for the gut-skin axis and sociodemographic factors (gender, age, ethnicity, education level, hometown demographic area, and monthly allowance) among students in the School of Health Sciences, USM, Kubang Kerian, Kelantan.

1.4.2 SPECIFIC OBJECTIVES:

1.   To determine the association between knowledge towards probiotics for the gut-skin axis and sociodemographic factors of students in the School of Health Sciences at USM.

2.   To determine the association between attitudes towards probiotics for the gut-skin axis and sociodemographic factors of students in the School of Health Sciences at USM.

3.   To determine the association between practices towards probiotics for the gut-skin axis and sociodemographic factors of students in the School of Health Sciences at USM.

1.5   RESEARCH HYPOTHESIS

1.5.1   Hypothesis 1:

Null hypothesis (HO): There is no association between knowledge towards probiotics for the gut-skin axis and sociodemographic factors among School of Health Science students at USM.

Alternative hypothesis (HA): There is an association between the knowledge towards probiotics for the gut-skin axis and sociodemographic factors among School of Health Science students at USM.

1.5.2   Hypothesis 2:

Null hypothesis (HO): There is no association between the attitudes towards probiotics for the gut-skin axis and sociodemographic factors among School of Health Science students at USM.

Alternative hypothesis (HA): There is an association between attitudes towards probiotics for the gut-skin axis and sociodemographic factors among School of Health Science students at USM.

1.5.3   Hypothesis 3:

Null hypothesis (HO): There is no association between practices towards probiotics for the gut-skin axis and sociodemographic factors among School of Health Science students at USM.

Alternative hypothesis (HA): There is an association between practices towards probiotics for the gut-skin axis and sociodemographic factors among School of Health Science students at USM.

1.6 SIGNIFICANCE OF STUDY

This finding will be beneficial in increasing the understanding of knowledge, attitudes, and practices of probiotics for the gut-skin axis, particularly among Health Science students in USM. This is essential as health science students will serve as future healthcare professionals who hold crucial roles in promoting health, primarily through their knowledge, attitudes, and daily practice in providing health care to the community. This would also be beneficial for the industry to determine the current trend of consumer buying behavior in terms of self-purchasing probiotics products. These results would also assist in developing a strong scientific basis that would be useful for the researchers and the food industry to understand the potential of these functional foods and how they can be promoted among consumers to improve their health, emphasizing gut health as the initial step (Areej Ali Alkhaldy, 2024). Additionally, this study may serve as current data in Malaysia related to probiotics for the gut-skin axis for the future research reference. The results of this research are also useful for health education programmes in integrating the practice of evidence-based benefits of probiotics based on the current trend among future health practitioners.
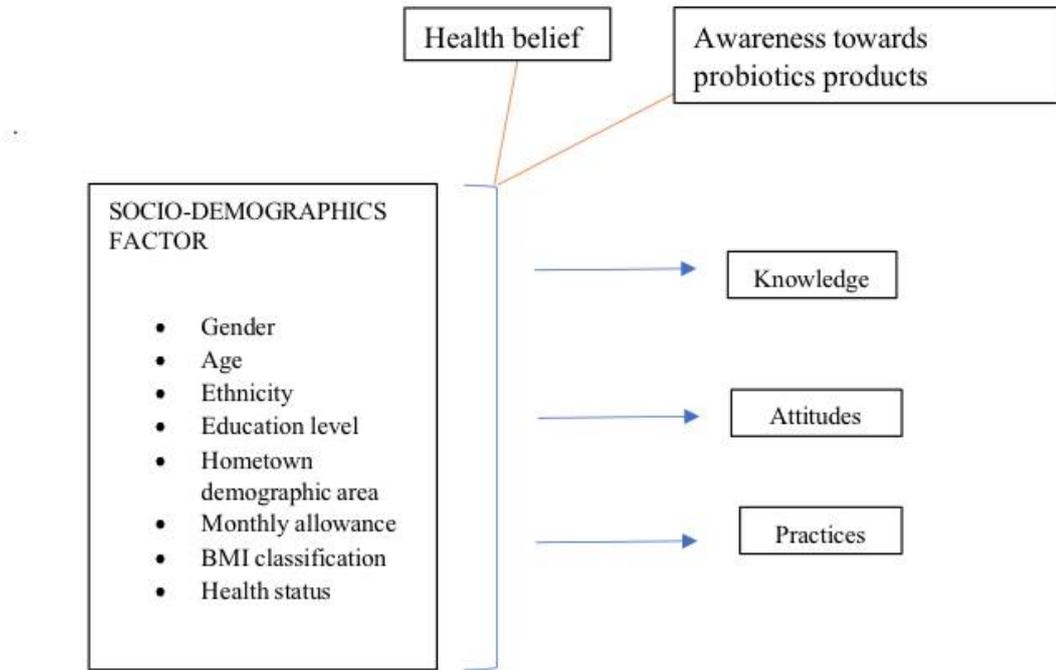
1.7 CONCEPTUAL FRAMEWORK

Figure 1: Conceptual framework

Figure 1 shows the conceptual framework adapted from Hazirah, (2016). This study investigated sociodemographic factors of health sciences students, which include gender, age, ethnicity, educational level, hometown demographic area, monthly allowance, BMI classification, and health status. These sociodemographic factors served as independent variables influencing knowledge, attitudes, and practices related to probiotics for the gut-skin axis. Meanwhile, the orange lines indicate the factors that was not being studied, that is, health beliefs and awareness towards probiotic products.

CHAPTER 2: LITERATURE REVIEW

2.1 TYPES OF PROBIOTICS

Many studies have explored probiotics in different contexts, including their types of strains and their sources. According to Min et al. (2023), probiotics commonly comprise lactic acid-producing bacteria such as *Lactobacillus* species. Western fermented food like yogurt and sauerkraut often contains this type of bacteria and it can also grow naturally in the gastrointestinal tract (Min et al., 2023). Hill et al. (2014) also highlighted some of the *Lactobacillus* species in probiotics, such as *Lactobacillus acidophilus, Lactobacillus rhamnosus, Lactobacillus plantarum, and Lactobacillus casei*. Meanwhile, in the local context, Ilyanie et al. (2024) stated that local Malaysian fermented foods like *belacan, tapai, budu,* and *tempoyak* may have a possible probiotic impact due to their high content of lactic acid bacteria (LAB) such as *L.plantarum* strains. This strain is recognized as a potential probiotic bacterium as it can neutralize dangerous pathogens and are able to survive in the harsh environment of the gastrointestinal tract. Nonetheless, there are limited studies in Malaysia that emphasize the significance of public awareness in the utilization of specific probiotic strains for the gut-skin axis.

Another type of probiotic bacteria species that naturally populates the gastrointestinal tract is known as *Bifidobacteria*. This strain type is remarkably abundant in lactating infants (Roberfroid et al., 2010). *Bifidobacteria* are crucial for the early stages of immune system development as they help in activating the function of dendritic and macrophage cells to fight against inflammation in the body (Gavzy et al., 2023).

The specific strain that also has a probiotic effect is called *Saccharomyces boulardii*. This is particularly due to its high stability in the digestive system and remains unaffected by antibiotics. Other research has also established that the *S. Boulardii* strain is able to prevent diseases related to the gastrointestinal tract. Therefore, this type of strain is commonly incorporated in probiotic supplements (McFarland, 2010). Lactic acid bacteria such as *Streptococcus thermophilus* are also usually incorporated into the production of dairy products, including yogurt and cheese. The strain's fermentation process not only provides health benefits to humans but also has the ability to survive in extremely acidic conditions of the stomach, making it a potential probiotic bacterium (Nionelli et al., 2014). An additional type of probiotic strain is *Propionibacterium freudenreichi*. It is usually utilized in dairy-based production, like Swiss cheese. The propionic acid produced by this species is the main contributor to enhancing the texture and flavour of cheese. This strain is also capable of regulating and strengthening immune function in humans (Huang et al., 2018).

From all the points out findings, there are still insufficient studies in Malaysia that highlight how far this knowledge is familiar and utilized among consumers regarding the health benefits that each probiotics strains hold. This suggests the significance gap in knowledge, attitude, and practice of probiotics towards the gut-skin axis or future healthcare professionals, particularly among Health Science students in USM, Kubang Kerian, Kelantan.

BENEFITS OF PROBIOTICS FOR SKIN

According to Guéniche et al. (2012), the gut microbiota's role in immunological mechanisms is closely related to skin conditions. For example, the *Lactobacillus* strain is capable of enhancing the functions of the skin protective layer and overcoming substance P-induced skin inflammation responses. Clinical observations have found that a six-week oral *Lactobacillus johnsonii* strain has greatly promoted the recovery of skin immunological function after it has been suppressed by ultraviolet (UV). Another study also showed wrinkled formation from UV exposure in mice was effectively reduced by oral tyndalized *Lactobacillus acidophilus* (Stergios, 2024).

Probiotics are also beneficial in skin brightening by inhibiting the production of tyrosinase. Tyrosinase is the enzyme responsible for melanin production through melanogenesis, which contributes to hyperpigmentation of the skin, such as melasma and freckles, due to sun damage (Pillaiyar et al., 2017). Lactic acid and lipoteichoic acid from *Lactobacillus* strains are shown to be responsible for the mechanism of skin brightening as they suppress the tyrosinase effect in melanin production, which leads to melanogenesis suppression (Huang et al., 2020).

Probiotics merely support in maintaining skin moisture by preserving skin barrier integrity and lowering trans-epidermal water loss (Harding et al., 2000). Ra et al. (2014) have revealed that consumption of probiotic strains, specifically *Lactobacillus plantarum*, in mice for 8 weeks has increased the concentration of ceramide and inhibited trans-epidermal water loss. This is crucial for protecting skin hydration and barrier function

against UV radiation (Ra et al., 2014). Additionally, findings from Baba et al. (2010) suggested, oral ingestion of fermented milk containing *Lactobacillus helveticus* in hairless mice for 4 weeks highlighted positive protection against dermatitis and successfully retained the skin barrier by decreasing the trans-epidermal water loss. These experiments have emphasized the potential of probiotics in maintaining skin moisture to combat skin disorders due to dryness (Stergios, 2024). However, these investigations have only been conducted on animal-based studies and not directly on humans. Thus, there are still limited studies that can prove how far these potential benefits of probiotics are able to work similarly in humans.

Moreover, probiotics are also effective in delaying skin aging due to photoaging, such as sun exposure, and chronological aging, which is the natural aging process in humans. This significant study was unveiled via research by Gervason et al. (2019). They highlighted the probiotic bacteria, *Sphingomonas hydrophobicum* (SH) able to hinder skin aging through skin reconstruction and inhibit P16 and P21 aging proteins compared to the control group. This strain can also support skin renewal by suppressing the enzymes associated with the aging process, the SA-β-galactosidase. SH extract supplementation also marked an alleviation in fibrillin-1 and versican, which are strongly linked to decelerating the aging process in cells. Fibrillin-1 is the protein responsible for promoting the production of elastic skin fibers, while versican is the large proteoglycan in the extracellular matrix that plays a role in inhibiting fibroblast apoptosis (Sheng et al., 2005).

Additionally, probiotics have the potential to treat skin disorders such as acne, atopic dermatitis (AD), psoriasis, and rosacea, including alopecia (Stergios, 2024). Stergios (2024) claimed that probiotics can treat acne due to their ceramide production

induced by applying lactic acid from *Streptococcus thermophilus* for a week. This is crucial in preserving skin hydration in order to create antibacterial surroundings and fight against acne bacteria, *Cutibacterium acnes* (França, 2020). This mechanism, which is related to ceramides also applied in relieving symptoms of atopic dermatitis (Stergios, 2024).

There is also scientific evidence that probiotics potentially treat skin conditions that are affected by immune function and inflammation, such as psoriasis and rosacea. This is because probiotics influence the body's histamine and help minimize inflammation. They limit the levels of inflammatory substances (TNF-α, IL-12, and MCP-1) by acting on specific receptors in immune cells (Cristofori et al., 2021). Probiotics alter the interaction of specific receptors in immune cells such as macrophages and dendritic cells, thereby suppressing the inflammation in the body by triggering anti-inflammatory cytokine production and concurrently inhibiting the production of pro-inflammatory cytokines. In contrast, according to Cristofori et al (2021), Lipopolysaccharides (LPS) will induce inflammation by binding to endothelial cells. The consumption of probiotics helps in reducing inflammation by lowering lipopolysaccharides (LPS) by increasing the amount of gut microbiome community and inhibiting the breakdown of tight junction protein, resulting in protection against health conditions related to inflammation (Cristofori et al., 2021).

Despite the fact that various studies have emphasized the potential benefits of probiotics for skin health through the gut, there is still limited research that investigates how these findings have been translated into public knowledge, attitudes, and practices of probiotics for skin health, as the existence studies have primarily focused on laboratory

and clinical findings. This gap underlines the need to further investigate how the clinical findings of probiotics have been understood and applied by the public community in the Malaysian context, particularly among Health Science students in Kubang Kerian, Kelantan.

2.2 KNOWLEDGE, ATTITUDE, AND PRACTICE OF PROBIOTICS

Kaseon et al (2021) have researched consumer acceptance of fermented drinks in Malaysia and found that out of 400 respondents, only 30% of them consumed fermented drinks, and the rest never knew about this. Age and income greatly influence their willingness to buy fermented drinks at a reasonable price. On the other hand, only 54% of respondents knew about functional foods that included probiotics.

According to Hazirah (2016), among 222 respondents from students in the faculty of medicine and health sciences at the Universiti Putra Malaysia (UPM), half of the respondents had poor knowledge about probiotics, 56.8% had negative attitudes, and 70.3% had poor practice toward probiotics and probiotic food products. This outcome indicated low knowledge, attitude, and practice toward probiotics at that time.

Ong et al. (2023) have studied undergraduate health science students' knowledge and attitudes, including the use of probiotics, particularly for the gut and skin. In this research, socio-demographic characteristics resulted in various outcomes. 48% of 221 health science students had good knowledge of probiotics, 67.4% had a moderate attitude, and 69.2% had poor practice. This shows higher knowledge regarding probiotics compared to a previous study by Hazirah (2016). However, the practices of probiotics are still categorized as low in this recent study.

Despite a study by Ong et al (2023) showing an increase in trends regarding Knowledge, Attitude, and practice towards probiotics compared to Hazirah (2016), there

is still a gap of knowledge, attitude, and practice towards probiotics as the practice of probiotics from both findings remains fall under the low category. In contrast, health science students who are expected to have better knowledge and attitude towards probiotics align with the expectation, as the knowledge and attitude among them demonstrate improvement across a period of time, while attitude among different groups persists at a below-optimal level throughout. Additionally, sparse research that has focused on probiotics related to the gut-skin axis as published research primarily explored knowledge, attitude, and practice of probiotics for the general health concern. This reveals a noticeable gap in the area of probiotics related to gut-skin axis in the context of Knowledge, attitude, and practice that primarily focus on the current local setting, which is among health science students in Kubang Kerian, Kelantan, Malaysia.

CHAPTER 3: METHODOLOGY

3.1   RESEARCH DESIGN

This research employed a cross-sectional study design among health science students at Universiti Sains Malaysia (USM), Kubang Kerian, Kelantan. The participants were obtained using convenience sampling to facilitate participant recruitment. One of the advantages of this study was that it was cost-effective and time-efficient. The data were collected from a large sample of participants in a short time frame at a single point in time, which allowed data to be collected easily. This cross-sectional study aimed to provide insights into the knowledge, attitudes, and practices related to probiotics for the gut-skin axis among health students at USM.

3.2   STUDY AREA

This study was conducted at USM, Kubang Kerian, Kelantan. This location was considered for the selection of participants to assess a higher variety of demographic settings in a specified area. This helped to obtain a better understanding of knowledge, attitudes, and practices toward probiotics for the gut-skin axis based on sociodemographic factors among students.