Knowledge, Attitude, and Practice Towards Probiotics and Its Association with Gut Health Among the General Public in Malaysia

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ABSTRACT

In this current era, although probiotics are commonly found in our daily foods, pharmaceutical companies have developed probiotics as supplements in many forms due to increased interest towards probiotics. Knowledge of the general public towards probiotics and their attitudes towards probiotics still need to be explored in Malaysia. Our study aimed to investigate the level of knowledge, attitude, and practice towards probiotics and their association with gut health among the general public in Malaysia. A cross-sectional study was conducted by recruiting the adult general population in Malaysia. Demographic characteristics, knowledge, attitudes and practice towards probiotics were collected via an online survey. Data was analysed by using the T-test and Oneway ANOVA by using SPSS (version 27). At the end of our study, we conclude that the general public in Malaysia has a mean knowledge score of 6.53 out of 10 and a mean knowledge of gut health of 10.14 out of 17. Gender, ethnicity, monthly family income, and education levels were the factors associated with respondents' knowledge of probiotics. Age, ethnicity, occupation, and education level were the factors related to knowledge of gut health. In conclusion, the public knowledge of probiotics in Malaysia is moderate, and the knowledge of gut health is moderate. However, the attitude towards probiotics among the public in Malaysia is mostly positive. With this finding, healthcare personnel and dieticians could be able to make effective and efficient plans to create a more health-conscious and informed community on the benefits of probiotics when integrated into their daily lifestyles, as well as a proactive approach to gut health.

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INTRODUCTION

In the era of an ever-advancing field of healthcare and pharmaceuticals, there is now an increase in the awareness of maintaining one's health among the public. The World Health Organization (WHO) defines probiotics as "live microorganisms which, when administered in adequate amounts, confer a health benefit on the host" [1]. Probiotics can be easily found in our everyday lives, and many members of the public lack the knowledge and awareness to use them beneficially [2]. Fermented foods such as yogurt, tempeh, kimchi, and miso have a certain amount of probiotics that may be beneficial to our gut health. As there is an increased interest in probiotics, pharmaceutical companies have developed capsules, powders, and tablets that have been made convenient for people to consume on-the-go and have proved to be beneficial for gut health.

According to WHO, the definition of 'gut health' is a state of physical and mental well-being in the absence of gastrointestinal complaints that require the consultation of a doctor, in the absence of indications or risks of bowel disease, and the absence of confirmed bowel disease. Gut microbiomes participate in vital processes including digestion, energy homeostasis and metabolism, the synthesis of vitamins and other nutrients, and the development and regulation of immune function. It also contributes to the production of numerous compounds that enter the blood and affect various tissues and organs of the body [3].

Probiotics were found to provide multiple benefits—not only reducing cholesterol and low-density lipoprotein (LDL) but also improving coexisting risk factors such as body mass index (BMI), waist circumference, and inflammatory biomarkers [4].

A study conducted in Jordan was designed to evaluate Jordanians' awareness and perception of probiotics and their willingness to use these nutritional supplements as a part of their daily diet. Among them, 64.0% reported that they were willing to take probiotics. Only 17.1% of the surveyed participants knew that probiotics were not dead microorganisms. Only 55.0% of participants believed that probiotics were safe to consume [5].

In a cross-sectional study conducted in 2017 among healthcare professionals in Ahmedabad, India revealed that the majority of the respondents believed that probiotics are useful for patients. Nearly 50% preferred probiotic-enriched food as a better choice than probiotic drugs. Almost half of them agreed that probiotics can significantly affect the outcome of any therapy and approximately half of the professionals prescribe probiotics more than five times a week [6].

Regarding awareness of gut health, a cross-sectional study conducted in Australia revealed that most of the participants had a good awareness of gut health as they were able to recognise the terms 'gut flora' and a large number of participants identified yoghurt gut health, a cross-sectional study conducted in Australia revealed that most of the participants had a good awareness of gut health as they were able to recognise the terms 'gut flora' and a large number of participants identified yoghurt as a possible

natural source of healthy bacteria. Meanwhile, probiotic users yield better results regarding awareness of gut health [7].

When Malaysian consumers were asked about the definition of probiotics, results showed that only 81.9% of respondents answered correctly that probiotic is defined as live microorganisms, although 87% of them responded that they were aware of the term probiotic.

5.1% did not know the term, and 6.5% presumed it to be drugs and chemicals in food [8]. Another cross-sectional study was done on Malaysian health science undergraduates, which revealed that 48% of the participants had good knowledge of probiotics, while 69.2% exhibited poor practices with regard to probiotics [9]. However, literature on knowledge and perception of gut health and its awareness among Malaysians is still limited. Therefore, this study aimed to investigate the level of knowledge, attitude, and practice towards probiotics and association with gut health among the general public in Malaysia.

METHODS

Study Design and Setting

This cross-sectional study that was conducted from October to November 2023 among the general adult population in Malaysia.

Sample Size and Sampling

The study's sample size was calculated using the OpenEpi sample size calculator. The expected frequency of adequate knowledge among respondents was considered to be 80% [10]. The confidence interval was set to 95%, with 4% margin of error. While taking into consideration the 10% non-response rate, the final total sample size of the study is 427.

The respondents were recruited by non-probability sampling via convenience sampling and snowball sampling. The inclusion criteria for this study were the general public living in Malaysia, aged 18 years and above, who voluntarily agreed to participate in our research study and complete all the required parts of the questionnaire after agreeing on the consent section of the form. The exclusion criteria for this study were the general public who was not able to read English or Malay.

Data Collection

The data was collected through a Google form survey questionnaire. The survey link was shared with family members, friends and through them, to their respective social circles.

We also shared the survey link via social media platforms such as Instagram and WhatsApp.

The questionnaire included five sections: (1) Demographic information, (2) Knowledge towards probiotics, (3) Attitude towards probiotics, (4) Knowledge towards gut health, and (5) Practice of probiotics among the general public in Malaysia.
The responses for knowledge towards probiotics were recorded as 'Yes', 'No', 'I don't know', and multiple-choice questions. Attitude towards probiotics was recorded with a five-point Likert Scale (Strongly agree, agree, neutral, disagree, strongly disagree). Knowledge towards gut health and the practice of probiotics included multiple-choice questions.

Data Analysis

The qualitative variables were demographic variables, analyzed by frequency and percentage. The quantitative variables were knowledge, attitudes, and practice of probiotics. The total scores were calculated and reported with mean and standard deviation. T-test and one-way ANOVA were used to identify the associated factors. The data collected from the respondents were analyzed using SPSS (Version 27).

Ethical Considerations

An informed consent was obtained from the participants and the participation was voluntary.

The Research Ethics Committee, Manipal University College Malaysia (MUCM), granted the research ethics approval to conduct this study.

RESULTS

Table 1 presents the demographic characteristics of the respondents from the general population in Malaysia. A total of 450 respondents consented to participate in our study. 45.88% of respondents were male, whereas 54.12 % were women. 56.89% of participants were aged below 36, and 43.11% were aged 36 and above. Regarding ethnicity, Malay accounted for 10.22%, Chinese 20.22%, Indian 40.89%, and others 28.67% (Table 1).

Table 1. Demographic characteristics of the respondents (n=450)

Demographic characteristics	n(%)
Gender (n=449)	
Male	206 (45.88)
Female	243 (54.12)
Age	
Below 36 years	256 (56.89)
36 years and above	194 (43.11)
Mean (SD)	35.60 (15.49)
Minimum – maximum	18-82
Ethnicity	
Malay	46 (10.22)
Chinese	91 (20.22)
Indian	184(40.89)
Others*	129 (28.67)
Nationality	
Malaysian	438 (97.33)
Non-Malaysian	12(2.67)
Place of residence	
Urban area	386 (85.78)
Rural area	64 (14.22)
Occupation	
Employed	202 (44.89)
Unemployed	54 (12.00)
Students	194 (43.11)
Education level**	
Secondary Education	56 (12.45)
Pre-University Level	105 (23.33)
Tertiary Education	289 (64.22)
Income	
Bottom 40 (< RM4850)	180 (40.00)
Middle 40 (RM4850 and RM10970)	163 (36.22)
Top 20 (>RM10970)	107 (23.78)

Table 2 shows the knowledge towards probiotics among the general public in Malaysia. Among the respondents, the majority (95.78%) have ever heard about probiotics. More than 90% of the respondents correctly selected probiotics as live microorganisms. 83.78% of the respondents first heard about probiotics through the internet, 82.89% of participants answered through doctor/healthcare, 78.44% of participants answered via friends/family, and 70.22% answered through advertisements. Average participants have moderate knowledge as they have an average score of 6.53 out of 10 (Table 2).

Table 2. Knowledge towards Probiotics among the general public in Malaysia (n= 450)

Question	n (%)
Having heard about the term 'Probiotics'	
Yes	431 (95.78)
No	19 (4.22)
Opinion on probiotics	
Live microorganism	407 (90.44)
Chemicals	12 (2.67)
Drugs	25 (5.56)
Others	6 (1.33)
Source of probiotics information for the first time	
Advertisement	
Yes	316 (70.22)
No	143 (29.78)
Newspaper	
Yes	151 (33.56)
No	299 (66.44)
Internet	
Yes	377 (83.78)
No	73 (16.22)
School	
Yes	190 (42.22)
No	260 (57.78)
Friends/Family	
Yes	353 (78.44)
No	87 (21.56)
Doctor/Healthcare	
Yes	373 (82.89)
No	77 (17.11)
Preparation of probiotics	
Capsules	

Yes	363 (80.67)
No	87 (19.33)
Fresh Milk	
Yes	298 (66.22)
No	152 (33.78)
Yoghurt	
Yes	420 (93.33)
No	30 (6.67)
Fermented food	
Yes	333 (74.00)
No	117 (26.00)
Incorporating probiotics in your daily meals	
Yes	266 (59.11)
No	93 (20.67)
I don't know	91 (20.22)
Probiotics disrupt the balance of normal microorganisms found in the digestive system	
Yes	134 (29.78)
No	198 (44.00)
I don't know	118 (26.22)
Consumption of probiotics must be done regularly over a long time	
Yes	237 (52.66)
No	71 (15.78)
I don't know	142 (31.56)
Probiotics increase the secretion of anti-inflammatory cytokines and antibodies	
Yes	182 (40.45)
No	28 (6.22)
I don't know	240 (53.33)
Probiotics increase the secretion of anti-inflammatory cytokines and antibodies	
Yes	235 (52.22)
No	57 (12.67)
I don't know	158 (35.11)
	Mean (SD)
Total knowledge score about probiotics	6.53 (1.59)

Table 3 shows the general public's knowledge of gut health in Malaysia. A total of 93.78% answered that microorganisms that naturally live in the gut are the correct option. Regarding the sources of gut bacteria, 98.00% of participants answered yogurt. The total knowledge score about gut health has a mean (SD) of 10.14 (3.28) (Table 3).

Table 3. Knowledge towards gut health among general public in Malaysia (n=450)

Question	Frequency (%)
Meaning of gut flora	
Microorganisms that naturally live in the gut	422 (93.77)
Surgical procedures in the gut	7 (1.56)
Disease or infection in the gut	21 (4.67)
Good sources of good bacteria for the gut?	
Yoghurt	
Yes	441 (98.00)
No	9 (2.00)
Fish	
Yes	132 (29.33)
No	318 (70.67)
Honey	
Yes	212 (47.11)
No	238 (52.89)
Fruit and vegetables	
Yes	340 (75.56)
No	110 (24.44)
Knowledgeable about the role of the gut microbiota in gut health problems such as constipation, diarrhoea, inflammatory bowel disease, colorectal cancer	
Yes	183 (40.67)
No	267 (59.33)
Have ever read studies on the role of gut microbes in health and diseases	
Yes	169 (37.56)
No	281 (62.44)
Imbalance of good and bad bacteria in the gut plays a role in developing autism and attention deficit disorder	
Yes	210 (46.67)
No	240 (53.33)
Imbalance of good and bad bacteria in the gut plays a role in developing inflammatory bowel disease	
Yes	421 (93.56)
No	29 (6.44)

Imbalance of good and bad bacteria in the gut plays a role in developing diabetes, obesity	
Yes	314 (69.78)
No	136 (30.22)
Imbalance of good and bad bacteria in the gut plays a role in developing autoimmune diseases	
Yes	278 (61.78)
No	172 (38.22)
Knowledge about Crohn's disease	
Yes	267 (59.33)
No	183 (40.67)
Organ affected by Crohn's disease	
Heart	2 (0.44)
Liver	13 (2.89)
Intestine	278 (61.78)
It's an infectious disease	3 (0.67)
I don't know	154 (34.22)
Availability of medical therapy for Crohn's disease	
Yes	175 (38.88)
No	43 (9.56)
I don't know	232 (51.56)
Knowledge about ulcerative colitis	
Yes	256 (56.89)
No	194 (43.11)
Organ affected ulcerative colitis disease	
Heart	3 (0.67)
Liver	8 (1.78)
Intestine	276 (61.33)
It's an infectious disease	5 (1.11)
I don't know	158 (35.11)
Availability of medical therapy for ulcerative colitis	
Yes	206 (45.78)
No	17 (3.78)
I don't know	227 (50.44)
	Mean (SD)
Total Knowledge Score about Gut Health	10.14 (3.28)

Table 4 shows the attitude towards probiotics among the general public in Malaysia. More than half of the respondents were agreeing to neutral to the statements in the attitude domain (Table 4).

Table 4. Attitude towards probiotics among the general public in Malaysia (n=450)

Item	Frequency (%)				
	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Probiotics are safe to consume	125 (27.78)	217 (48.22)	57 (12.67)	9 (2.00)	42 (9.33)
Consuming probiotics are beneficial for health	121 (26.89)	225 (50.00)	55 (12.22)	10 (2.22)	39 (8.67)
Probiotics play a vital role in improving human health.	114 (25.33)	160 (35.56)	128 (28.44)	7 (1.56)	41 (9.11)
Probiotics may be an alternative option to prevent complaints of the digestive system due to pathogenic infection	85 (18.89)	163 (36.22)	152 (33.78)	14 (3.11)	36 (8.00)
Probiotics is an alternative option to treat complaints of the digestive system due to pathogenic infections	81 (18.00)	141 (31.33)	167 (37.11)	23 (5.11)	38 (8.45)
Probiotics may prevent the side effects of antibiotics (e.g: nausea, vomiting, diarrhea, rash, stomach upset etc.)	60 (13.33)	144 (32.00)	177 (39.33)	35 (7.78)	34 (7.56)
I want to learn more about probiotics	127 (28.22)	193 (42.89)	76 (16.89)	14 (3.11)	40 (8.89)

Table 5 shows the general public's practice towards probiotics in Malaysia. In our study, 60.22% of the respondents consumed probiotics, while 9.11% took it every day. The majority of them consumed probiotics to improve digestive issues (89.56%) and to promote gut health (81.33%) (Table 5).

Table 5. Practice towards probiotics among the general public in Malaysia (n=450)

Item	Frequency (%)
Consumption of probiotics	
Yes	271 (60.22)
No	179 (39.78)
Preference to consume probiotics	
Food	230 (51.11)
Supplement	220 (48.89)
Frequency of probiotics consumption in a week	
Not taking	173 (38.45)
Once in a week	123 (27.33)
2-5 times a week	113 (25.11)
Everyday	41 (9.11)
Searched for additional information regarding probiotics prior to consumption	
Yes	164 (36.44)
No	286 (63.56)
Reasons for consuming probiotics	
Improve digestive issues	
Yes	403 (89.56)
No	47 (10.44)
Preventing diseases	
Yes	306 (68.00)
No	144 (32.00)
Reduce allergy reactions	
Yes	241 (53.56)
No	209 (46.44)
Lack of reason	
Yes	139 (30.89)
No	311 (69.11)
Consuming probiotics to promote gut health	
Yes	366 (81.33)
No	84 (18.67)
Recommending your family and close relatives to consume probiotics	
Yes	411 (91.33)
No	39 (8.67)

Table 6 describes the association between the demographic characteristics and factors associated with knowledge towards probiotics among the respondents. The female respondents had a higher mean value of 6.75 (SD = 1.59) in comparison to the male respondents, who had a lower mean value of 6.26 (SD = 1.55). Our results indicated that gender was statistically significant with a P value of 0.001. The “others” ethnicity group had the highest mean value of 6.76 (SD = 1.70), followed by the Malay ethnic group with a mean value of 6.74 (SD = 1.82), the Chinese ethnic group with a mean value of 6.65 (SD = 1.60) and the Indian ethnic group, with the lowest mean value among the four categories which was 6.26 (SD = 1.41). There was a significant difference between the mean knowledge scores among different ethnicities (P =0.023). The respondents who completed their tertiary education had the highest mean value of 6.69 (SD = 1.69), followed by secondary education with a mean value of 6.25 (SD = 1.81) and pre-university education with a mean value of 6.25 (SD = 1.07). The mean knowledge scores among different educational levels were statistically significant in our research study (P = 0.020). Regarding family income, the mean scores of those in the bottom 40, middle 40, and top 20 income groups were 6.31 (SD = 1.49), 6.60 (SD = 1.70), and 6.79 (SD = 1.55), respectively. The mean knowledge scores among different family incomes were also found to be statistically significant (P = 0.036) (Table 6).

Table 6. Factors associated with knowledge towards probiotics among respondents (n=450)

Demographic characteristics	Mean (SD)	Mean difference	95%CI of mean difference	P
Gender				
Male	6.26 (1.55)	-0.49	-0.78, -0.20	0.001[a]
Female	6.75 (1.59)			
Age				
Below 36 years	6.43 (1.44)	-0.24	-0.54,0.07	0.125[a]
36 years and above	6.66 (1.76)			
Ethnicity				
Malay	6.74 (1.82)			0.023[b]
Chinese	6.65 (1.60)			
Indian	6.26 (1.41)			
Others*	6.76 (1.70)			
Nationality				
Malaysian	6.55 (1.59)	0.80	-1.11,1.71	0.086[a]
Non-Malaysian	5.75 (1.36)			
Place of Residence				
Urban Area	6.51 (1.58)	-0.13	-0.55,0.29	0.545[a]
Rural Area	6.64 (1.69)			
Occupation				
Employed	6.66 (1.69)			0.090[b]
Unemployed	6.70 (1.83)			
Students	6.34 (1.39)			
Education Level				
Secondary Education	6.25 (1.81)			0.020[b]
Pre-University Level	6.25 (1.07)			
Tertiary Education	6.69 (1.69)			
Monthly Family Income				
Bottom 40 (< RM4850)	6.31 (1.49)			0.036[b]
Middle 40 (RM4850 and RM10970)	6.60 (1.70)			
Top 20 (>RM10970)	6.79 (1.55)			

* Others include Bumiputera Sabah, Bumiputera Sarawak, Punjabi and Ceylonese

[a] Independent T- test b One way ANOVA

Table 7 reports the factors associated with attitudes towards probiotics among the general population in Malaysia. In our study, the findings highlight that there was no statistically significant association between gender, age, ethnicity and nationality and attitude towards probiotics (Table 7).

Table 7. Factors associated with attitudes towards probiotics among respondents (n=450)

Demographic characteristics	Mean (SD)	Mean difference	95%CI of mean difference	P
Gender				
Male	25.38 (6.33)	-0.25	-1.52,1.01	0.694[a]
Female	25.64 (7.34)			
Age				
Below 36 years	25.34 (5.80)	-0.32	-1.68,1.04	0.643[a]
36 years and above	25.66 (8.20)			
Ethnicity				
Malay	27.35 (6.06)			0.147[b]
Chinese	26.05 (6.90)			
Indian	24.92 (6.60)			
Others*	25.22 (7.60)			
Nationality				
Malaysian	25.45 (6.86)	-1.05	-5.04,2.94	0.607[a]
Non-Malaysian	26.50 (9.54)			
Place of residence				
Urban Area	25.59 (6.78)	0.73	-1.34,2.79	0.487[a]
Rural Area	24.86 (7.84)			
Occupation				
Employed	26.02 (7.41)			0.178[b]
Unemployed	24.11 (9.23)			
Students	25.30 (5.50)			
Education level				
Secondary Education	24.21 (8.32)			0.159[b]
Pre-University Level	24.94 (4.78)			
Tertiary Education	25.92 (7.27)			
Income				
Bottom 40 (< RM4850)	24.62 (6.30)			0.135[b]
Middle 40 (RM4850 and RM10970)	25.86 (7.41)			
Top 20 (>RM10970)	26.36 (7.10)			

* Others include Bumiputera Sabah, Bumiputera Sarawak, Punjabi and Ceylonese
[a] Independent T- test b One way ANOVA

Table 8 shows factors associated with gut health knowledge among respondents. Age, ethnicity, occupation, and education level were found to have a significant association with gut health knowledge. The mean score in responders aged below 36 years old was higher than responders aged 36 years old and above with the mean difference of 1.85, the finding was significant as the p-value was <0.001. For ethnicity, Indians had the highest mean score, whereas the Malay had the lowest knowledge of gut health, p-value (<0.001). For occupation, students had the highest mean score of gut health knowledge while employed participants had the lowest mean score, this finding was significant as the p-value was <0.001. For education level, those who held Pre-University Level had the highest mean score whereas those who held only secondary education had the lowest, and this finding was significant as the p-value was <0.001 (Table 8).

Table 8. Factors associated with gut health knowledge among respondents (n=450)

Demographic characteristics	Mean (SD)	Mean difference	95%CI of mean difference	P
Gender				
Male	10.36 (3.35)	0.43	-0.19,1.04	0.172[a]
Female	9.94 (3.22)			
Age				
Below 36 years	10.93 (2.97)	1.85	1.26, 2.44	<0.001[a]
36 years and above	9.09 (3.38)			
Ethnicity				
Malay	8.70 (3.09)			<0.001[b]
Chinese	9.99 (3.30)			
Indian	11.03 (3.02)			
Others*	9.48 (3.38)			
Nationality				
Malaysian	10.15 (3.30)	0.31	-1.58,2.20	0.745[a]
Non Malaysian	9.83 (2.76)			
Place of residence				
Urban Area	10.25 (3.24)		-0.11,1.63	0.086[a]
Rural Area	9.48 (3.50)			
Occupation				
Employed	8.97 (3.14)			<0.001[b]
Unemployed	9.70 (3.59)			
Students	11.47 (3.28)			
Education level				
Secondary Education	9.38 (3.39)			<0.001[b]
Pre-University Level	11.51 (2.69)			
Tertiary Education	9.79 (3.33)			
Income				
Bottom 40 (< RM4850)	10.41 (3.25)			0.055[b]
Middle 40 (RM4850 and RM10970)	9.64 (3.28)			
Top 20 (>RM10970)	10.43 (3.28)			

* Others include Bumiputera Sabah, Bumiputera Sarawak, Punjabi and Ceylonese

[a] Independent T- test b One way ANOVA

Association between knowledge on gut health, knowledge about probiotics, attitudes towards probiotics, and probiotic usage among respondents are reported in Table 9. Every unit increase in knowledge about probiotics, the odds of using probiotics increased by 1.51 (P <0.001). Every unit increase in attitudes towards probiotics score, the odds of using probiotics increased by 1.03 (P = 0.043) (Table 9).

Table 9. Association between knowledge on gut health, knowledge, attitudes towards probiotics, and probiotic usage among respondents (n=450)

	Probiotics Users	Probiotics non-users	Exp (B)	95%CI	P
	Mean (SD)	Mean (SD)			
Knowledge on gut health	10.00 (3.40)	10.34 (3.10)	0.97	0.92, 1.03	0.286
Knowledge about probiotics	6.91 (1.46)	5.96 (1.62)	1.51	1.32, 1.72	<0.001
Attitudes towards probiotics	26.02 (7.83)	24.66 (5.20)	1.03	1.00, 1.06	0.043

DISCUSSION

This study was conducted to investigate knowledge, attitudes, and practice regarding probiotics. We found that the general public in Malaysia had moderate knowledge about probiotics and a positive attitude toward them. The findings revealed that more than 60% of the sample from the general public in Malaysia consumed probiotics in their lives.

This study revealed that the respondents had a moderate level of knowledge. Furthermore, there was an association between probiotic usage and knowledge and attitude towards probiotics. In the previous study, 87% of the respondents were aware of the term probiotics [8], which was lower compared to our study in that the majority (95.78%) of respondents were aware of probiotics. In the modern era, probiotics are no longer a new word, as the public becomes more health conscious, with the immense interest in consuming new supplements in their day-to-day proven by the global nutraceuticals and supplements market that has steadily grown over the past decade and was reported to be worth almost $353 billion USD in 2019 [11].

The respondents from our study gained information about probiotics from the most popular sources which were advertisements (70.22%), internet (83.78%) and school (42.22%). As of January 2023, about 78.5 percent of the Malaysian population are active social media users according to Statista 2023. This explained why most of the respondents in our study had a higher level of awareness regarding probiotics since they were more exposed to social media. However, 4.22% of the respondents in our study did not have any information regarding probiotics. Hence, more exposure to probiotics should be done through various platforms to increase awareness and knowledge level of probiotics amongst the public.

In this study, female respondents had a higher knowledge of probiotics than male respondents. Similar studies related to probiotics also agree that females tend to have a more positive outlook on knowledge of probiotics as they are deemed to be more health conscious [9].

In our study, education level was found to be significantly associated with attitudes towards probiotics. Respondents who received tertiary education tend to have a positive attitude towards the topic compared with respondents who received pre-university and secondary education. The probable reason is that our research survey was shared among respondents aged 36 years and above who have completed their degrees and have a better understanding of and perception of the topic. A previous study done in Malaysia regarding probiotics usage and fresh milk also reported that respondents who received some form of tertiary education tended to have a more positive attitude and approach towards the topic [8].

In a previous study conducted by Khalesi et al., 66% of respondents were aware of gut health being microorganisms that naturally live in the gut [7]. However, a majority of 93.78% participants were aware of gut health in our study. The study of gut ecology has emerged as one of the most active and exciting fields in biology and medicine. The respondents in our study were asked for good sources of gut health. The correct choice being yogurt was selected by 98% of our respondents. Yogurt is widely consumed across the world, as it provides a good to excellent source of highly bioavailable protein and an excellent source of calcium as well as a source of probiotics that may provide a range of health benefits [12].

Awareness and affected organs of Crohn's disease and Ulcerative colitis were investigated in our study, and 61.78% of the respondents correctly answered as intestines for Crohn's disease and 61.33% for Ulcerative colitis. This knowledge level of Crohn's disease and Ulcerative colitis in the previously conducted study was reported as 37.1% correctly answered for Crohn's disease and 73.8% for Ulcerative colitis [13]. The rising number of cases seen in Malaysia has contributed to increasing the awareness of Ulcerative colitis and Crohn's disease. The prevalence rate of Ulcerative colitis and Crohn's disease respectively were 15.67 and 7.36 per 100,000 persons in Malaysia, and the prevalence was calculated based on the whole Kuala Lumpur population in 2018 and expressed as the number of cases per 100,000 persons [14].

In our study, the mean score of gut health knowledge among those who aged below 36 years old is higher than 36 years old and above. Previous study regarding awareness of gut health problems (inflammatory bowel disease) done in Saudi revealed that those who were in the age group of 31-40 years old had the highest mean score, followed by 41-50 years old and 21-30 years old as they had the same mean score. This is due to participants from these age groups being the largest social media consumers in Saudi. Thus, it is assumed that social media caused better awareness in these age groups [15]. The different results may be due to the demographic of social media users by age in Malaysia. For example, Facebook is the second most used social media in Malaysia, and those aged 24-34 years old are the largest consumers of Facebook (30% of the user base), followed by those 18-24 years [16].

In our study, students had a higher mean score of gut health knowledge than employed participants who had the lowest mean score. In a previous cross-sectional study done in Saudi Arabia, employed participants had the highest mean score of awareness of the gut health problem (inflammatory bowel disease) followed by students, however the findings were not significant as the p-value (0.06) is higher than 0.05 [15]. There is a difference in our result because students make up 43.11% in our demographic of respondents and most of them are medical students from the study institution thus they had a better knowledge in gut health compared to the general public.

The mean score of gut health is the highest in those who had pre-university level education followed by those who had Tertiary level education. Those who only had secondary education level scored the lowest mean score. This finding is similar to the previous cross-sectional study done regarding awareness level of colorectal cancer in Malaysia where post-secondary education level participants scored the highest mean knowledge score of warning signs and risk factors of colorectal cancer compared to those who were in or only had secondary level education [17]. Similar results were seen in a cross-sectional study regarding awareness level of Inflammatory Bowel disease where those who had post-secondary education level (Bachelor, Masters Phd) had mean higher scores than those who only had secondary education level [15].

The high level of agreement and positive attitudes towards probiotics was observed in our findings. Based on a previous study done in Malaysia, the majority of respondents had positive perceptions toward the safety of probiotics and the benefits of probiotics in human health [8]. This high level of agreement aligns with the growing body of evidence suggesting positive effects of probiotics on gut health. Meta-analyses have indicated several areas where probiotics can exert health benefits such as certain types of diarrhoea, constipation, and inflammatory diseases of the intestine [18].The participants in our study have also actively recommended their family and close relatives to consume probiotics compared to the previous study with a frequency of 91.33%, the latter being 52.9 % [10].

The results show a significant association between knowledge-attitude on probiotics variables. The variables imply that the association is statistically significant. In our study, most of the respondents displayed a moderate level of knowledge and attitude on probiotics. This corresponds with previous studies done in Malaysia and Indonesia. This can be explained by the fact that this observational study design precluded the researchers from assessing any behavioral developments of the respondents [8, 9]. The association results highlight the need for more evidence based information on probiotics to improve the level of knowledge and attitude of the general population.

STRENGTHS AND LIMITATIONS

This study has several strengths. First, we were able to assess the knowledge amongst the general public in Malaysia towards probiotics and gut health, nevertheless there was an association of the knowledge amongst probiotics users against non-users. There were results filling in the research gap, as other studies had a significantly lower percentage of knowledge towards probiotics amongst the respondents [8], as well as the lack of correlation between knowledge of gut health and probiotics.

Our study design is cross sectional; thus it is very difficult to establish temporal relationship. In our sampling, we use a non-probability sampling method, which causes our sample not to be truly representative of the Malaysian population. When accounting for students, most of the students were from our institution which is a medical school as we aggressively promote the questionnaire in our university. Thus, the sample who are students doesn't represent students in Malaysia especially to those who are studying in non-medical fields. This really affects our study as medical students have a better understanding and knowledge regarding human's health compared to the public.

CONCLUSION

It can be concluded that the knowledge of the general public in Malaysia towards probiotics is moderate and the knowledge towards gut health is moderate. However, the attitude towards probiotics among the general public in Malaysia is mostly positive as the median score for the majority of the statements was 4 (Agree), whereas the median score for the other 2 statements was 3 (Neutral). In our study, genders, ethnicity, monthly family Income and education levels were the factors associated with knowledge towards probiotics among respondents. On the other hand, age, ethnicity, occupation, and education level were the factors associated with knowledge towards gut health. There were no factors that were significant enough to be associated with attitudes towards probiotics. However, there was an association between probiotic usage with knowledge towards probiotics and attitudes toward probiotics. Probiotic users have a more positive attitude towards probiotics and score higher mean scores in knowledge of the probiotics.

The findings in our study will allow healthcare personnel and dieticians to understand the evolving knowledge, perception and attitude of the general public in Malaysia regarding probiotics and how it influence the population's gut health. With this finding, they will be able to make effective and efficient plans to create a more health-conscious and informed community on the benefits of probiotics when integrated into their daily lifestyles as well as a proactive approach to gut health.

RECOMMENDATION

Future studies could be conducted with a representative sample of the general population in Malaysia. It is also recommended that the sample should not be dominated by healthcare workers or students who are in the medical field as this will affect the mean knowledge score as they have wider knowledge regarding human's health than the general public. Moreover, researchers could instil the importance of probiotics by fostering partnerships with healthcare providers to integrate probiotic education into routine medical consultations, allowing individuals to receive personalized advice based on their health status, and in this context, their gut-health status. Probiotic-rich diets could also be a method to promote the consumption of probiotic-rich foods such as yogurt and fermented food. On the other hand, healthcare personnel and dieticians could also highlight the link between diet and gut-health, by emphasizing the connection between probiotic consumption and improving one's gut health. By implementing these recommendations, we could be able to develop a health-conscious and informed community on the benefits of probiotics when integrated into their daily lifestyles as well as a proactive approach to gut health.

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