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Knowledge, Attitude, and Practice toward Probiotics Among the General Adult Population in Malaysia

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Abstract

Background: Probiotics are live microorganisms that, when consumed or applied in sufficient amounts, bring health benefits to the host, according to the definition by the International Scientific Association for Probiotics and Prebiotics.

Objectives: This study aimed to explore the association between the understanding, beliefs, and behaviors of the Malaysian adult population regarding probiotics.

Patients and Methods: A cross-sectional study was carried out using convenience sampling technique among the general adult population in Malaysia, within a duration of 6 weeks during 2024, to explore how the understanding, beliefs, and behaviors of the adult population related to probiotics were associated with their awareness of the potential health benefits.

Results: Among 397 adults, the mean (±SD) scores were 10.2 ± 3.5 for knowledge, 5.1 ± 1.0 for attitude, and 6.0 ± 1.9 for practice. Overall, 32.0% had good knowledge, 89.7% positive attitudes, and 65.7% good practices. Most respondents (over 95%) recognized the benefits of probiotics, and 78.3% reported prior consumption. Multivariate logistic regression showed that Malaysian females were more likely to have good knowledge (AOR = 1.76, 95% CI: 1.14–2.70, p = 0.010). Malay ethnicity was associated with more favorable attitudes (AOR = 4.29, 95% CI: 0.80–23.00, p = 0.049), while Malaysian nationality was linked with lower odds of good practices (AOR = 0.69, 95% CI: 0.38–0.92, p = 0.019).

Conclusion: To gain the potential benefits of using probiotics for overall health and well-being, more studies are needed to fully understand their mechanisms and optimal applications. As our knowledge of microbiomes expands, so does the potential for probiotic interventions in supporting overall well-being.

Keywords: Knowledge, Attitude, Practice, Probiotic usage, Malaysia.

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Introduction

In recent decades, the popularity and incorporation of probiotics into daily diets have grown considerably, reflecting the increasing global interest in functional foods and preventive health care. Numerous studies have strongly recommended probiotic supplementation due to its wide range of health benefits (1). The International Scientific Association for Probiotics and Prebiotics defines probiotics as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host" (2) While traditionally recognized for their ability to promote gastrointestinal health, certain probiotic strains have been shown to produce systemic effects. These include hypocholesterolemia properties that aid in lowering blood cholesterol levels, thereby supporting cardiovascular health (3). According to the study done by Huang et al. (2018), some strains also exhibit indirect cancer-suppressing potential by modulating immune responses and generating anti-inflammatory metabolites. Beyond these effects, probiotics have been reported to positively influence cognitive performance through the gut–brain axis, as demonstrated in the study by Huang et al. (2018) (3). In sports medicine, research by Aykut et al. during 2023 found probiotics effective and safe for preventing and treating gastrointestinal discomfort caused by strenuous exercise, while also improving muscle energy production, muscle mass, strength, and aerobic capacity (4). The European Food Safety Authority (EFSA) has validated health claims related to yogurt, such as its ability to improve lactose tolerance in lactose-intolerant individuals (5). Additionally, epidemiological studies have linked the consumption of fermented soy products to a reduced risk of cardiovascular disease, illustrating the broader benefits of including probiotics in the diet (6). Probiotics may also play a role in colon cancer prevention through multiple mechanisms: reinforcing the intestinal mucus barrier, enhancing IgA production, downregulating inflammatory cytokines, and creating a hostile environment for harmful microorganisms via the secretion of antimicrobial compounds such as bacteriocins, nitric oxide, and hydrogen peroxide (6). Sociodemographic factors significantly influence probiotic awareness and consumption. Studies have shown that individuals with higher incomes are more likely to understand and use probiotic products, possibly due to increased access to health information, better education, and greater exposure to health-related products (7). Affordable and widely marketed options, such as fermented milk drinks like Yakult, remain the most popular probiotic sources (8). Nevertheless, consumption rates are still low in some regions, with one report noting that only 26.0% of the surveyed population consumed probiotics regularly (9). Furthermore, 6% reported never having used probiotics, and only 4% claimed complete knowledge of their benefits (10). Information about probiotics is primarily obtained through television and the Internet, indicating the importance of media in consumer education (11). However, even in areas with high prevalence of probiotic use, such as Sacramento, many consumers were unaware of the specific compositions of the products they consumed, highlighting the need for clearer educational resources (12). A study among dental students in Kerala showed that the students with a higher level of education had significantly better knowledge about and a positive attitude toward probiotics, with many students being active users or recommenders of probiotics in their practice (13). Effective communication and clear explanation from healthcare providers help patients understand the importance of adherence and motivate them to follow supplementation advice (14). In Malaysia, the prevalence of dietary supplement use among Malaysians is still lower compared to other countries (15, 16). In the United

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States and Europe, nearly half of the adult population reports consuming dietary supplements regularly, with the primary motivations being the maintenance and promotion of personal health (2, 14, 17, 18). In contrast, a study by Zaki et al., done during 2014, highlighted that the prevalence of dietary supplement usage among Malaysian adults is considerably lower. Recent research by Mang et. al., 2024 found that the relatively low adoption of supplements in Malaysia, with only 13.9% of Malaysian adults reporting the purchase of dietary supplements in the past month (10). Probiotic use has been increasingly recognized for its potential health benefits, yet public understanding and adoption vary widely across populations. In Malaysia, limited data exist on the knowledge, attitudes, and practices related to probiotics among the general adult population, despite growing global interest in functional foods. This study aimed to address this gap by assessing how awareness and perceptions influence the actual use of probiotics, providing insights for targeted health promotion and education. Additionally, the current study design explored how the understanding, beliefs, and behaviors of the adult population in Malaysia related to probiotics are associated with their awareness of the potential health benefits.

Materials and Methods

Dataset description: This research had employed the study design of a cross-sectional study, within a duration of 6 weeks during 2024. The study focused on the knowledge, attitude, and practice toward probiotics among the general adult population in Malaysia. In 2022, there were approximately 23 million adults in Malaysia, an increase from around 22.73 million adults in the previous year. Adults in our study were classified as individuals above the age of 18 years (19).

Sample size determination: The study population was the adult population (18 years old and above) in Malaysia, which was approximately 26 million adults according to United Nations age-breakdown projections. The minimal sample size required in our study was 358 adults, which was calculated using the OpenEpi statistical calculator, with an anticipated percentage frequency of 80.5% good awareness related to probiotic usage according to previous literature, by assuming a 95% Confidence Interval (CI) and a marginal error of 5%. By taking into consideration of non-responsive rate of 20%, the final minimal sample size required in our study was 290 adults (17).

Sampling: This study was conducted using convenience sampling among the general adult population in Malaysia through online questionnaires. Participants were selected based on availability during the data collection period. Inclusion criteria covered adults aged 18 years and above, currently residing in Malaysia, regardless of gender, ethnicity, education level, or income, and who provided informed consent. Exclusion criteria included individuals below 18 years of age, adults living outside Malaysia, and those who did not provide consent. A total of 400 responses were collected; three were excluded for being under 18, resulting in a final analyzed sample of 397 participants.

Data collection: An online questionnaire was created using Google Forms and distributed via social media platforms such as WhatsApp, Instagram, and Facebook. The target population was the general adult population in Malaysia, with specific inclusion and exclusion criteria applied. The questionnaire consisted of seven sections: (1) preferred language, (2) information sheet and informed consent, (3) demographics, (4) knowledge about probiotics, (5) knowledge of health conditions for which probiotics are beneficial, (6) attitude toward probiotics, and (7) practice of probiotics. Sections three to six were adapted from a validated source—the Saudi University in Riyadh, Saudi Arabia—which had previously published a cross-sectional study on

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the knowledge, attitude, and practice of probiotics among Saudi healthcare students (20). The improvised questionnaire was used to collect data for this study, aiming to assess knowledge, attitudes, and practices (KAP) related to probiotics. The questions, developed by the research team, underwent content validation by experts and were revised according to their feedback, achieving a satisfactory CVI (Content Validity Index) score of 0.85. The demographics section included nine questions on gender, age (classified into four groups: 18–24, 25–44, 45–64, and 65+), ethnicity, nationality, occupation, highest education level, and relationship status to obtain accurate categorical data. Knowledge of probiotic use was evaluated in Section 4 through 10 items, including multiple-choice, true/false, and yes/no questions, and an item assessing the ability to identify probiotic foods. Section 5 assessed knowledge of health conditions for which probiotics are beneficial using true/false questions. Section 6 measured attitudes toward probiotics through six true/false and yes/no items. Practice was assessed in Section 7 through yes/no questions, along with items on consumption frequency and types of probiotic products used. The total possible score was 34 points: 19 for knowledge (categorized as good, fair, or poor), six for attitude (positive or negative), and nine for practice (positive or negative). The scoring system for our questionnaire was adapted from previously published knowledge, attitude, and practice (KAP) studies in public health and nutrition research, where binary classification is commonly used. For knowledge, scores ≥75% of the total was categorized as "Good," and scores <75% as "Poor." For attitude and practice, the median score was used as the cut-off, with scores ≥median classified as "Positive" (attitude) or "Good" (practice), and scores <median as "Negative" or "Poor," respectively. This binary classification method had been applied in multiple KAP studies assessing health behaviors (e.g., dietary practices, vaccination uptake, hygiene habits) and was supported in the literature (21-23). The approach allowed for clear interpretation and comparison while reducing category overlap, which can occur in multi-tier scoring.

Statistical Analysis

Data was analyzed using descriptive statistics for knowledge, attitude, and practice (KAP) scores. Microsoft Excel was used for data entry and processing, while IBM SPSS Statistics version 24 was employed for analysis. For categorical variables such as age, gender, ethnicity, the frequencies and percentages were calculated. For continuous variables, KAP scores, mean, and standard deviation, were computed. Associations between variables were tested using appropriate statistical methods based on data type. The chi-square test was applied to examine associations between categorical variables. Simple logistic regression and multiple logistic regression (backward method) was used according to previous literatures to analyze the significant factors associated with knowledge, attitude and practice related to probiotics usage. Data were presented as the crude and adjusted odds ratio (OR) with the 95% confidence interval (CI) and their corresponding p-values. P-values of <0.05 were considered to be statistically significant.

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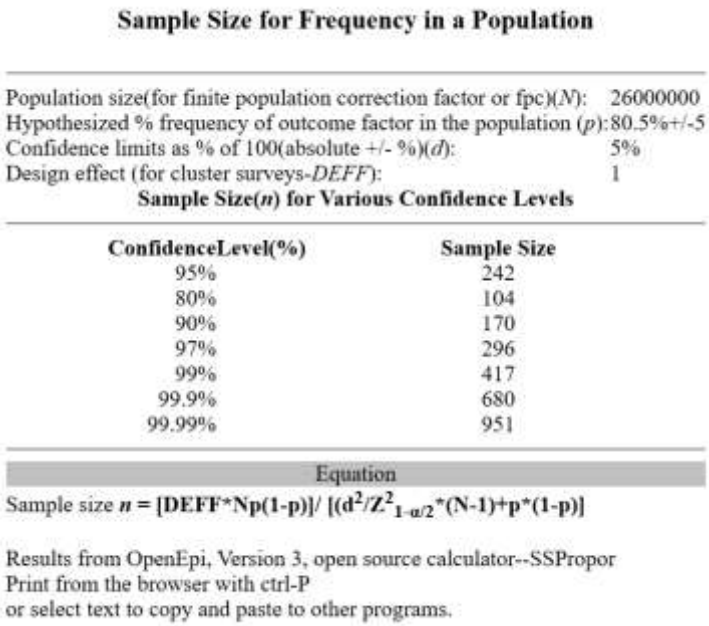

Sample Size for Frequency in a Population

Population size(for finite population correction factor or fpc)(*N*): 26000000
Hypothesized % frequency of outcome factor in the population (*p*): 80.5%+/-5
Confidence limits as % of 100(absolute +/- %)(*d*): 5%
Design effect (for cluster surveys-*DEFF*): 1

Sample Size(*n*) for Various Confidence Levels

ConfidenceLevel(%)	Sample Size
95%	242
80%	104
90%	170
97%	296
99%	417
99.9%	680
99.99%	951

Equation

Sample size $n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]$

Results from OpenEpi, Version 3, open source calculator--SSPropor
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

Figure 1. Sample size determination using OpenEpi (Version 3).

Results

Sociodemographic characteristics of the respondents: Out of 397 participants, a higher proportion were female (67.8%) compared to male (32.2%). This indicated a female-dominated sample, which may influence the generalizability of findings. The study population was predominantly young, with the majority aged 18–24 years (74.1%). Smaller proportions were aged 25–44 years (9.1%) and 45–64 years (16.6%), while no respondents were aged 65 and above. This highlights that the sample was skewed towards younger adults. Most participants were Malaysian (62.2%), while a notable proportion were non-Malaysian (37.8%), reflecting the multicultural context of the study setting. The largest ethnic group was Indian (58.2%), followed by Malay (24.4%) and Chinese (11.6%), with 5.8% belonging to other ethnic groups. This ethnic distribution may reflect the institutional or community profile where the study was conducted. A significant majority were single (79.1%), while 18.9% were married. Only 1% each were divorced or widowed. This finding was consistent with the younger age profile of the participants. Most respondents had completed tertiary education (79.6%), while 18.6% had secondary education and very few had no schooling (0.8%) or only primary education (1%). This suggests that the study population was highly educated.

The dominant group was students (70%), followed by participants employed in the private sector (12.6%), government sector (6%), and self-employed (6.3%). Smaller groups included the unemployed (3.8%) and retired individuals (1.3%). Participants were distributed across different income categories, with the highest proportion in the M40 middle-income group (39.3%), followed by T20 high-income (32.5%), and B40 lower-income (28.3%). This shows a relatively balanced representation of socioeconomic groups. It was shown that most participants were from West Malaysia (85.4%), while a smaller group resided in East Malaysia (14.6%). Knowledge, Attitude, and Practice Levels Regarding Probiotics. In Figure 2, the study assessed the knowledge, attitude, and practice (KAP) levels regarding probiotics among participants, with only 32% of participants demonstrating good knowledge about probiotics, while

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68% had poor knowledge. This indicated a substantial knowledge gap in the population. A large majority (89.7%) showed a good attitude toward probiotics, suggesting that most participants perceive probiotics positively or are open to using them, despite limited knowledge while the rest 10.3% had a negative attitude. Moreover, about 65.7% of participants reported good practice regarding probiotics, whereas 35.3% reported poor practice. This showed that more than half of the participants translated their positive attitude into actual behavior, although practice levels are lower than attitude levels. Although knowledge about probiotics was low, participants generally had a positive attitude, and a majority practiced probiotic use. Table 2. Illustrated notable associations between certain demographic characteristics and participants' knowledge toward probiotic use. Knowledge levels were significantly influenced by gender ($p = 0.039$), with males more likely to demonstrate poor knowledge than females. Nationality also showed significance ($p = 0.046$), as Malaysians reported slightly better knowledge compared to non-Malaysians. Similarly, Participants from West Malaysia were more knowledgeable (good knowledge: 33.9%) compared to those from East Malaysia (20.7%), with the association being significant ($p = 0.046$). On the other hand, no significant associations were observed for age, ethnicity, marital status, education, occupation, or household income with
knowledge (all $p > 0.05$). This suggested that probiotic-related knowledge was fairly consistent across these demographic categories, indicating that awareness of probiotics may be spreading widely regardless of socioeconomic background, educational attainment, or occupational status.Table 3. illustrated notable associations between certain demographic characteristics and participants' attitudes toward probiotic use. Regarding attitudes, ethnicity was the only significant factor with $p = 0.035$. Chinese participants had the highest proportion of negative attitudes (17.4%), compared to Indians (11.7%), Others (13%) and Malays (3.1%).. This pattern may reflect cultural beliefs, dietary preferences, or perceptions of probiotics across different ethnic communities. In contrast, variables such as age, gender, nationality, marital status, education, occupation, household income, and residing area were not significantly associated with attitudes, indicating that positive attitudes toward probiotics were generally widespread across the population regardless of socioeconomic or educational differences ($p > 0.05$).

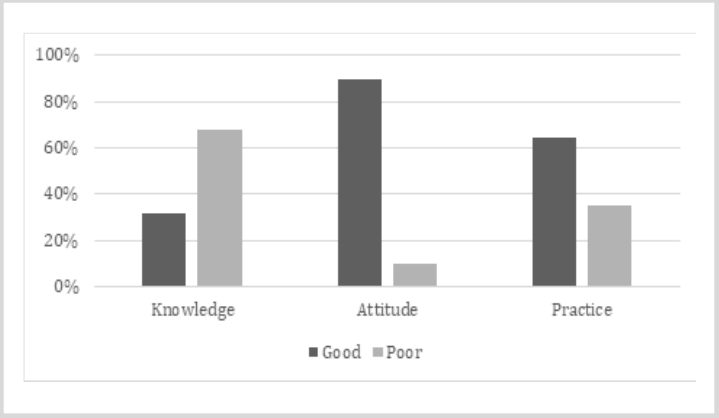

Figure 2. Knowledge, Attitude, and Practice Levels Regarding Probiotics.

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Table 1. Sociodemographic characteristics of the respondents (N = 397).

Variables	N	Percentage
Gender		
Male	128	32.2%
Female	269	67.8%
Age		
18 - 24 years old	294	74.1%
25 - 44 years old	36	9.1%
45 - 64 years old	66	16.6%
65+ years old	0	0.0%
Nationality		
Malaysian	247	62.2%
Non-Malaysian	150	37.8%
Ethnicity		
Malay	97	24.4%
Chinese	46	11.6%
Indian	231	58.2%
Others*	23	5.8%
Relationship status		
Single	314	79.1%
Married	75	18.9%
Divorced	4	1%
Widowed	4	1%
Highest Completed Education Level		
No schooling	3	0.8%
Primary Education	4	1%
Secondary education	74	18.6%
Tertiary education	316	79.6%
Occupation		
Student	278	70%
Unemployed	15	3.8%
Self-employed	25	6.3%
Working in the government sector	24	6%
Working in the private sector	50	12.6%
Retired	5	1.3%
Total Household Income		
B40 (<RM 6,338)	112	28.3%
M40 (RM 6,338 - RM 10,959)	156	39.3%
T20 (>RM 10,959)	129	32.5%
Residing Area		
West Malaysia	339	85.4%
East Malaysia (Sabah & Sarawak)	58	14.6%
* Other ethnicities include groups not listed, such as Bumiputera Sabah and Sarawak, in addition to other non-Malay, non-Chinese, and non-Indian ethnicities.		

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Table 2. Association between sociodemographic characteristics and knowledge towards probiotic usage among respondents in Malaysia using chi-square test (N=397).

Variables	Level of Knowledge		x^2 (df)	p-value
	Poor N (%)	Good N (%)		
Age			3.933 (3)	.248
18-24	204 (69.4)	90 (30.6)		
25-44	21 (58.3)	15 (41.7)		
45-64	45 (68.2)	21 (31.8)		
65 and above	0 (0.0)	1 (100)		
Gender			4.242 (1)	.039*
Female	174 (64.7)	95 (35.3)		
Male	96 (75.0)	32 (25.0)		
Nationality			3.976 (1)	.046*
Malaysian	159 (64.4)	88 (35.6)		
Non-Malaysian	111(74.0)	39 (26.0)		
Ethnicity			2.623 (3)	.450
Chinese	36 (78.3)	10 (21.7)		
Indian	154 (66.7)	77 (33.3)		
Malay	64 (66.0)	33 (34.0)		
Others	16 (69.6)	7 (30.4)		
Relationship status			2.006 (3)	.646
Divorced	3 (75.0)	1 (25.0)		
Married	46 (61.3)	29 (38.7)		
Single	218 (69.4)	96 (30.6)		
Widowed	3 (75.0)	1 (25.0)		
Highest completed education level			1.611 (3)	.736
No schooling	3 (100.0)	0 (0.0)		
Primary education	3 (75.0)	1 (25.0)		
Secondary education	49 (66.2)	25 (33.8)		
Tertiary education	215 (68.0)	101 (32.0)		
Occupational status			4.024 (5)	.557
Retired	3 (60.0)	2 (40.0)		
Self-employed	13 (52.0)	12 (48.0)		
Student	190 (68.3)	88 (31.7)		
Unemployed	10 (66.7)	5 (33.3)		
Working in government sector	18 (75.0)	6 (25.0)		
Working in private sector	36 (72.0)	14 (28.0)		
Total Household Income			0.903 (2)	.633
B40 (<RM6,338)	80 (71.4)	32 (28.6)		
M40 (RM6,338-RM 10,959)	103 (66.0)	53 (34.0)		
T20 (>RM10,959)	87 (67.4)	42 (32.6)		
Residing area			3.987 (1)	.046*
East Malaysia	46 (79.3)	12 (20.7)		
West Malaysia	224 (66.1)	115 (33.9)		

The p-values marked with an asterisk (*) indicated statistical significance at $p < 0.05$. For cells with expected counts <5, Fisher's Exact Test p-values were reported.

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Table 3. Association between sociodemographic characteristics and attitude towards probiotic usage among respondents in Malaysia using chi-square test (n=397).

Variables	Level of Attitude		x^2 (df)	p-value
	Negative (%)	Positive N (%)		
Age			6.331(3)	.097
18-24	37(12.6)	257(87.4)		
25-44	1(2.8)	35(97.2)		
45-64	3(4.5)	63(95.5)		
65 and above	0(0)	1(100)		
Gender			.963 (1)	.326
Female	25 (9.3)	244 (90.7)		
Male	16 (12.5)	112 (87.5)		
Nationality			2.352(1)	.125
Malaysian	21(8.5)	226(91.5)		
Non-Malaysian	20(13.3)	130(86.7)		
Ethnicity			8.606 (3)	.035*
Chinese	8 (17.4)	38 (82.6)		
Indian	27 (11.7)	204 (88.3)		
Malay	3 (3.1)	94 (96.9)		
Others	3 (13)	20 (87)		
Relationship status			4.107(3)	.250
Divorced	1(25)	3(75)		
Married	4(5.3)	71(94.7)		
Single	35(11.1)	279(88.9)		
Widowed	1(25)	3(75)		
Highest completed education level			2.240 (3)	.524
No schooling	1 (33.3)	2 (66.7)		
Primary education	0 (0)	4 (100)		
Secondary education	7 (9.5)	67 (90.5)		
Tertiary education	33 (10.4)	283 (89.6)		
Occupational status			1.258 (5)	.939
Retired	0 (0)	5 (100)		
Self-employed	2 (8)	23 (92)		
Student	30 (10.8)	248 (89.2)		
Unemployed	1 (6.7)	14 (93.3)		
Working in government sector	2 (8.3)	22 (91.7)		
Working in private sector	6 (12)	44 (88)		
Total Household Income			.961 (2)	.619
B40 (<RM6,338)	10(8.9)	102(91.1)		
M40 (RM6,338-RM 10,959)	19(12.2)	137(87.8)		
T20 (>RM10,959)	12(9.3)	117(90.7)		
Residing area			.214 (1)	.644
East Malaysia	5 (8.6)	53 (91.4)		
West Malaysia	36 (10.6)	303 (89.4)		

The p-values marked with an asterisk (*) indicated statistical significance at $p < 0.05$. For cells with expected counts <5, Fisher's Exact Test p-values were reported.

Table 4. illustrated notable associations between certain demographic characteristics and participants' practices toward probiotic use. A significant association was noted (p = 0.018), with 72.0% of non-Malaysians practicing probiotics more often than Malaysians (60.3%). Furthermore, Indians reported the highest good practices (70.1%), compared to Malays (59.8%), Chinese (50.0%), and others ethnicity (60.9%) and the

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association was significant with p <0.05 (p = 0.039). Other variables such as age, gender, marital status, education, occupation, income, and residing area were not significantly linked to probiotic practices (p > 0.05). This indicated that probiotic practices were uniform across most sociodemographic groups, suggesting that consumption patterns may be less dependent on socioeconomic resources and more influenced by cultural norms and personal health choices.

Table 4. Association between sociodemographic characteristics and practice towards probiotic usage among respondents in Malaysia using chi-square test (N=397).

Variables	Level of Practice		x^2 (df)	p-value
	Poor N (%)	Good N (%)		
Age			1.858 (3)	.700
18-24	102 (34.7)	192 (65.3)		
25-44	11 (30.6)	25 (69.4)		
45-64	27 (40.9)	39 (59.1)		
65 and above	0 (0.0)	1 (100.0)		
Gender			.865 (1)	.352
Female	99 (36.8)	170 (63.2)		
Male	41 (32.0)	87 (68.0)		
Nationality			5.573 (1)	.018 *
Malaysian	98 (39.7)	149 (60.3)		
Non-Malaysian	42 (28.0)	108 (72.0)		
Ethnicity			8.508 (3)	.039*
Chinese	23 (50.0)	23 (50.0)		
Indian	69 (29.9)	162 (70.1)		
Malay	39 (40.2)	58 (59.8)		
Others	9 (39.1)	14 (60.9)		
Relationship status			2.751 (3)	.493
Divorced	1 (25.0)	3 (75.0)		
Married	29 (38.7)	46 (61.3)		
Single	110 (35.0)	204 (65.0)		
Widowed	0 (0.0)	4 (100.0)		
Highest completed education level			.933 (3)	.835
No schooling	1 (33.3)	2 (66.7)		
Primary education	1 (25.0)	3 (75.0)		
Secondary education	23 (31.1)	51 (68.9)		
Tertiary education	115 (36.4)	201 (63.6)		
Occupational status			3.224 (5)	.673
Retired	3 (60.0)	2 (40.0)		
Self-employed	6 (24.0)	19 (76.0)		
Student	100 (36.0)	178 (64.0)		
Unemployed	6 (40.0)	9 (60.0)		
Working in government sector	9 (37.5)	15 (62.5)		
Working in private sector	16 (32.0)	34 (68.0)		
Total Household Income			2.372 (2)	.300
B40 (<RM6,338)	35 (31.3)	77 (68.8)		
M40 (RM6,338-RM 10,959)	62 (39.7)	94 (60.3)		
T20 (>RM10,959)	43 (33.3)	86 (66.7)		
Residing area			.018 (1)	.893
East Malaysia	20 (34.5)	38 (65.5)		
West Malaysia	120 (35.4)	219 (64.6)		

The p-values marked with an asterisk (*) indicated statistical significance at p < 0.05. For cells with expected counts <5, Fisher's Exact Test p-values were reported.

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Overall, the results suggested that while probiotics were generally well-known and positively regarded across the population, certain demographic groups particularly males, Malaysians, West Malaysian residents, and some ethnic groups—may benefit from targeted health promotion strategies. Tailoring educational campaigns and interventions to address these disparities could help improve both knowledge and uptake of probiotics, ultimately supporting better health outcomes.

Knowledge towards probiotic usage: Female gender*Malaysian nationality was significantly associated with higher knowledge (AOR = 1.755, 95% CI: 1.142–2.699, p = 0.010). An interaction term was tested to assess effect modification between gender and nationality. This indicated that Malaysian females had 1.76 times higher odds of having good knowledge about probiotic usage compared to others. Hosmer-Lemeshow goodness of fit shown chi-square of 0.161 with 2 df and p value was 0.923 (not significant), meant that the model was fit well to the logistic regression. Omnibus tests of model coefficients gave us chi-square of 10.868 on 2 df and significant beyond p<0.001 (p=0.004). Therefore, adding variables such as female gender and the significant interactions of female gender * Malaysian nationality (as shown in Table 5) could improve the model. In this study, we can conclude that 2.7% of good knowledge towards probiotic usage was explained by the significant independent variables such as Malaysian females as stated in table 5 based on the Cox & Snell R Square value (0.027) in MlogR.

Attitude towards probiotic usage: Malay ethnicity was significantly associated with positive attitudes (AOR = 4.291, 95% CI: 0.800–23.003, p = 0.049). This suggested Malay respondents were about 4.3 times more likely to have favorable attitudes towards probiotic usage compared to non-Malays. However, the wide CI indicated variability and less precision in the estimate. Hosmer-Lemeshow goodness of fit shown chi-square of 0.130 with 4 df and p value was 0.998 (not significant), meant that the model was fit well to the logistic regression. Omnibus tests of model coefficients gave us chi-square of 16.621 on 6 df and significant beyond p<0.001 (p=0.011). Therefore, adding Malay ethnicity variable (as shown in Table 5) could improve the model. In this study, we can conclude that 1.4% of positive attitude towards probiotic usage was explained by the significant independent variable such as Malay ethnicity as stated in table 5 based on the Cox & Snell R Square value (0.014) in MlogR.

Practice towards probiotic usage: Malaysian nationality was significantly associated with practice (AOR = 0.691, 95% CI: 0.381–0.916, p = 0.019). This indicated that Malaysians had 31% lower odds of engaging in good probiotic-related practices compared to non-Malaysians. Hosmer-Lemeshow goodness of fit shown chi-square of 0.000 with 3 df and p value was 1.000 (not significant), meant that the model was fit well to the logistic regression. Omnibus tests of model coefficients gave us chi-square of 5.666 on 6 df and significant beyond p<0.001 (p=0.017). Therefore, adding Malaysian nationality variable (as shown in Table 5) could improve the model. In this study, we can conclude that 4.1% of good practice towards probiotic usage was explained by the significant independent variable such as Malay nationality as shown in table 5 based on the Cox & Snell R Square value (0.041) in MlogR.

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Table 5. Association between sociodemographic characteristics towards knowledge, attitude and practice regarding probiotic usage among respondents in Malaysia using Multiple Logistic Regression (MLogR) (N=397).

Variables	B	Adjusted OR (95% CI)	Wald (df)	p value
Association between sociodemographic variables and knowledge towards probiotic usage				
Female gender * Malaysian nationality	0.563	1.755 (1.142-2.699)	6.573 (1)	0.010
Association between sociodemographic variables and attitude towards probiotic usage				
Malay ethnicity	1.456	4.291 (0.800-23.003)	2.890 (1)	0.049
Association between sociodemographic variables and practice towards probiotic usage				
Malaysian nationality	-0.525	0.691 (0.381-0.916)	5.524 (1)	0.019
The p-values marked with an asterisk (*) indicated statistical significance at $p < 0.05$. 95%CI = 95% Confident Interval, AOR = Adjusted Odds Ratio, MlogR= Multiple Logistic Regression.				

Discussion

In this study, it was found that females had the best overall knowledge on probiotics, with 35. % of good knowledge, compared to males with 25.0% of good knowledge. Furthermore, knowledge was significantly influenced by gender, with males showing a higher proportion of poor knowledge than females, a finding consistent with previous studies that reported gender-related differences in awareness of probiotics. There was a notable difference in knowledge about probiotic products between genders. This finding was consistent with the finding from the study done in Philippines during 2021 which found that 31.4% of males were informed about probiotics, while a significantly higher percentage among 61.1%, of females (8). This suggested that females may have a better understanding of probiotic products than males. Participants aged 25–44 years had the highest proportion of good knowledge on probiotics (75.0%) in this study. This result was partially supported by another research article, which was conducted in Saudi Arabia. They found that younger age groups tend to have limited knowledge about probiotics, with only 26% of participants aged 18 to 25 being aware of probiotics in one study (24). The study done by Kaya et el. during 2025 showed that, while age may not have a significant effect on probiotic use, other factors, such as health status, may have a greater impact within specific age groups (25). Similarly, studies on probiotic use in relation to chronic kidney disease indicated that older people, particularly those over the age of 55, were more likely to consume probiotics (26). This may be because adults 25–44 are more exposed to health information, while older individuals use probiotics mainly for managing health conditions. Furthermore, knowledge on probiotics was highest among other ethnicities (68.2%), followed by Indians (63.3%), Chinese (61.4%), and Malays (60.0%) in our study. However, a U.S.-based outpatient survey examined who used probiotics and why during 2021 and found that probiotic use did not significantly differ across ethnic groups (White, Hispanic, Black, Other: $p = 0.60$); the data still underscored that usage patterns by ethnicity are commonly investigated in clinical settings (27). This may be due to differences in cultural dietary habits,

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health beliefs, and exposure to probiotic information, which can influence knowledge levels among ethnic groups even if overall usage does not differ significantly. Our study showed no significant link between household income and knowledge level, though the B40 group demonstrated higher knowledge than others. It was similar to the cross-sectional study done in Saudi Arabia during 2023; those with monthly incomes less than 10,000 SR (Saudi Riyal) were 2.5 times more likely to have average knowledge than the others with 20,000 SR monthly incomes (p = 0.0001–0.006 and OR = 2.202–2.877) (28). Furthermore, a Turkish study done in Istanbul during 2022 similarly reported more male adolescents (55.6%) than females (44.4%) expressing interest in adding probiotics to their drinks, a statistically significant difference [30]. Furthermore, a cross-sectional study done in China during 2023 reported that the Chinese population showed significantly more positive attitudes toward probiotics than Malay and Indian groups. (30). In our study, the 18–24 age group recorded the highest positive attitude scores, with a statistically significant association. Similarly, a study in Saudi Arabia found that positive scores were highest among individuals aged 35–46 years, with significant differences across age groups. Participants over 46 years, however, showed the highest negative attitude (83.3%), also with statistical significance. (31). Our study found no significant association between education level and attitude, though higher education appeared linked to more positive views. Similarly, a cross-sectional study done by Babina et al. during 2023 reported no significant correlation between knowledge and attitude among dentistry students and professors, despite overall positive attitudes (32). Similarly, AbuKhader et al. (2022) conducted research among Oman's medical sciences students, where they found that there were inconsistent findings in the students' attitudes toward probiotics, despite having higher knowledge (33). In our study, household income did not significantly influence attitudes toward probiotics, suggesting that economic status had minimal impact. Similar results were reported by McKerracher et al. (2023) in Canada, where socioeconomic factors did not predict probiotic attitudes during pregnancy. Likewise, a Hong Kong survey of 385 participants found that while education correlated positively with probiotic awareness, overall probiotic acceptance showed no significant link with income levels (34, 35). The study concluded that higher-income individuals used probiotics more, with socioeconomic factors influencing behavior more than health needs.Our study showed no significant association between gender and probiotic practice among Malaysian adults. Similarly, a study in Pakistan reported that male healthcare professionals had higher odds of good practice (OR = 0.442) than females (36). The lack of significant gender differences in probiotic practices may be due to similar health awareness, access, and behaviors between men and women in Malaysia. Moreover, the ethnicity was significantly associated with the probiotic practice, whereby Indian respondents had the highest proportion of good practices compared to Malay, Chinese and other ethnic groups. The findings aligned with the findings from previous study done by Blumberg JB et al. during 2017 stated that the use of dietary supplements, including probiotic supplements, differs across ethnic groups, suggested that cultural or socio-economic factors somewhat influenced on health-related probiotic consumption behaviors. (37). Similarly, Dwiyanto et al. (2021) demonstrated that ethnicity significantly influenced gut microbiota diversity among individuals residing within the same geographical setting. Nevertheless, these variations did not appear to directly correspond with differences in probiotic consumption practices (39). Furthermore, results from Malaysia and the Netherlands revealed varying

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patterns. In Malaysia, consumers across different ethnicities showed high awareness and favorable perceptions of probiotics particularly in fermented foods, while Dutch adults exhibited substantial consumption of fermented items, although awareness of probiotic-specific products was not explicitly broken down by ethnicity (39, 40). However, a result from national survey done in U.S. during 2022 found no significant link between ethnicity and probiotic use, suggesting factors like gender, education, and chronic illness may play a greater role (41). The findings from our study revealed that there was no statistically significant association between various education levels and the practice of consuming probiotics. This finding was contradictory to the result of a study conducted in Romania by Precup et al. during 2022, a study among Romanian consumers indicated that higher educational attainment was positively associated with greater knowledge, with educated individuals showing more favorable attitudes toward probiotics and prebiotics (42). Moreover, no significant difference was observed in probiotic practice levels between the B40 and M40 income groups in this study. This contrasted with a Costa Rican study done during 2013, which reported that probiotic product purchases were influenced by income. (11). In addition, a study in India by Raja BR et al. during 2011 on the market potential for probiotic supplements highlighted that rising incomes were a key driver of both industry growth and increased probiotic consumption (43). In our study, nationality (Malaysian vs. non-Malaysian) was significantly associated with overall knowledge, attitude, and practice regarding probiotics and their consumption.

Similarly, a 2020 study in Indonesia among health science students found significant correlations between knowledge and attitude, as well as between attitude and practice regarding probiotics for digestive health (44). Moreover, a study conducted in the United Arab Emirates by Alqaydi et al. during 2024 indicated that there was a significant positive correlation between attitude and practices, suggesting that individuals with positive attitudes towards probiotics and prebiotics are more inclined to consistently and sustainably incorporate these products into their routines (33). This may have occurred because cultural background, exposure to nutrition education, and access to probiotic products differed between nationalities, influencing their knowledge, attitudes, and consumption practices.

The multivariate logistic regression (MLogR) analysis further reinforced these findings by highlighting key predictors of knowledge, attitude, and practice. Female Malaysians were significantly more likely to possess good knowledge of probiotics compared to their male counterparts, supporting gender-based differences reported in other studies [6, 23, 32]. Malay ethnicity emerged as a predictor of positive attitudes, suggesting that cultural and dietary influences may shape perceptions of probiotic use. Interestingly, Malaysian nationality was inversely associated with probiotic practices, indicating that non-Malaysians in the sample were more likely to adopt favorable practices. These results emphasized the complex interplay of gender, ethnicity, and nationality in shaping probiotic-related KAP, and suggested that tailored educational strategies may be necessary to address these sociodemographic variations.

Conclusion

This study demonstrated a moderate to low levels of knowledge regarding probiotics, despite there were positive attitudes and relatively good practices towards probiotics using among general adults' population in Malaysia. These patterns indicated growing awareness of their health benefits and recognition of the synergistic role of probiotic usage in supporting gut health and overall well-being. The findings suggested strong potential for public health initiatives to further promote their use as part of a balanced diet. Continued research was warranted to better understand their mechanisms, optimal

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applications, and potential contributions to mental health. As our understanding of the human microbiome advances, probiotic-based strategies may become an increasingly valuable component of holistic health management. The findings in our study highlighted the importance of culturally sensitive and demographically targeted health promotion strategies. Public health authorities and healthcare providers could prioritize awareness campaigns among men, Malaysians residing in West Malaysia, and ethnic groups with less favorable attitudes and practices. In addition, interventions should address cultural perceptions and dietary habits that shape attitudes toward probiotics. By leveraging culturally tailored messages, expanding access to probiotic products, and incorporating education into broader nutrition and wellness programs, policymakers and health educators can bridge gaps in knowledge and encourage healthier practices across diverse population groups. Moreover, further study may explore public health awareness related to prebiotics usage alongside with probiotics for better understanding of the combination role in gut health. This study had some limitations, including its cross-sectional design, which prevented causal conclusions, and convenience sampling, which limited generalizability. Additionally, the sample had a high proportion of tertiary-educated respondents, which may reflect a selection bias due to the online distribution method and the voluntary nature of participation. As a result, the findings may not be fully generalizable to the wider Malaysian adult population, particularly those with lower educational attainment. Future research should employ stratified sampling or mixed recruitment strategies to ensure a more balanced representation across education levels. Moreover, longitudinal study designs should be done to assess changes over time for better accuracy and incorporate dietary biomarkers to validate self-reported probiotic and prebiotic usage. Expanding the sample to include diverse age groups and socioeconomic backgrounds would enhance generalizability.

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Ethical clearance: A six-week cross-sectional study, conducted in 2024, assessed knowledge, attitudes, and practices toward probiotics among Malaysian adults (≥18 years). Before participation, volunteers received an information sheet detailing the study's aims, procedures, and voluntary nature, with no incentives offered. Digital informed consent was obtained prior to the online questionnaire. Data access was restricted to the research team, and all information was handled with strict confidentiality and protected from unauthorized access. The Research Ethics Committee, Manipal University College Malaysia (MUCM), reviewed and approved the study protocol. (Ref no. MUCM/Research Ethics Committee – 005A/03/2024).

Conflict of interest: None.

Use of Artificial Intelligence (AI): The authors declare that they did not use generative artificial intelligence for creation or preparation this manuscript.

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المعرفة والموقف والممارسة تجاه البروبيوتيك بين عامة السكان البالغين في ماليزيا

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الملخص

الخلفية: البروبيوتيك كائنات دقيقة حية، عند تناولها أو استخدامها بكميات كافية، تُحقق فوائد صحية للمضيف، وفقًا لتعريف الجمعية العلمية الدولية للبروبيوتيك والبريبايوتيك.

الأهداف: تهدف هذه الدراسة إلى استكشاف وجود ترابط بين فهم السكان البالغين في ماليزيا و معتقداتهم وسلوكياتهم المتعلقة بالبروبيوتيك .

المرضى والطرق: أُجريت دراسة مقطعية باستخدام أسلوب أخذ العينات المريحة بين عامة السكان البالغين في ماليزيا، لمدة ٦ أسابيع خلال عام ٢٠٢٤، لاستكشاف كيفية ارتباط فهم السكان البالغين ومعتقداتهم وسلوكياتهم المتعلقة بالبروبيوتيك بوعيهم بالفوائد الصحية المحتملة.

النتائج: من بين ٣٩٧ بالغًا، كان متوسط الدرجات (± الانحراف المعياري) ١٠,٢ ± ٣,٥ للمعرفة، و٥,١ ± ١,٠ للموقف، و٦,٠ ± ١,٩ للممارسة. بشكل عام، كان لدى ٣٢,٠٪ من المشاركين معرفة جيدة، و٨٩,٧٪ مواقف إيجابية، و٦٤,٧٪ ممارسات جيدة. وأدرك معظم المشاركين (أكثر من ٩٥٪) فوائد البروبيوتيك، وأفاد ٧٨,٣٪ منهم بتناوله سابقًا. أظهر الانحدار اللوجستي متعدد المتغيرات أن الإناث الماليزيات كنّ أكثر ميلًا لامتلاك معرفة جيدة (AOR = 1.76، فاصل ثقة ٩٥٪: ١,١٤-٢,٧٠، قيمة P = 0.010). وارتبطت الأصول العرقية الملايوية بمواقف أكثر إيجابية (AOR = 4.29، فاصل ثقة ٩٥٪: ٠,٨٠-٢٣,٠٠، قيمة P = 0.049)، بينما ارتبطت الجنسية الماليزية بانخفاض احتمالات اتباع الممارسات الجيدة (AOR = 0.69، فاصل ثقة ٩٥٪: ٠,٣٨-٠,٩٢، قيمة P = 0.019).

الاستنتاج: لتحقيق الفوائد المُحتملة لاستخدام البروبيوتيك على الصحة العامة، يلزم إجراء المزيد من الدراسات لفهم آلياته وتطبيقاته المثلى بشكل كامل. مع اتساع معرفتنا بالميكروبيوم، تتسع أيضًا إمكانات تدخلات البروبيوتيك في دعم الصحة العامة.

الكلمات المفتاحية: المعرفة، السلوك، الممارسة، استخدام البروبيوتيك، ماليزيا.

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تاريخ القبول: ١٩ ايلول ٢٠٢٥

تاريخ النشر: ٢٥ كانون الأول ٢٠٢٥

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