Knowledge and awareness of Palestinian health care professionals towards probiotics, prebiotics and synbiotics: a cross-sectional study from Palestine

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Abstract

Probiotics are live microorganisms believed to confer health benefits when consumed appropriately. Prebiotics are non-digestible food components that promote health by encouraging the growth or activity of beneficial microorganisms. Synbiotics are a combination of probiotics and prebiotics. This study aimed to assess the knowledge and awareness of Palestinian healthcare professionals regarding probiotics, prebiotics, and synbiotics. A cross-sectional study was conducted across the West Bank using a structured questionnaire, and descriptive analysis was performed using SPSS. The results indicated that 68.5% of physicians and 83.4% of pharmacists were aware of probiotics, whereas only 37% of physicians and 48% of pharmacists had knowledge of prebiotics. Awareness of synbiotics was even lower, with only 20% of physicians and 26.6% of pharmacists reporting familiarity. These findings suggest that while there is a reasonable level of knowledge about probiotics, awareness of prebiotics and synbiotics is significantly lacking, which limits their use. Enhancing knowledge of these products could be facilitated through workshops, ongoing education, and the involvement of medical representatives.

Introduction

The human Gastrointestinal Tract (GIT) is home to various species of microorganisms that provide numerous health benefits, such as protection against infections from other microbes and stimulation of immune function, among others.[1] The interaction between gut microorganisms and the host's health begins at birth, with microbial diversity evolving throughout the host's life.[2] This relationship contributes to the development of the intestinal epithelial layer, the enteric nervous system, the intestinal vascular system, and the mucosal innate immune system.[3] The gut microflora plays an integral role in a range of nutritional, metabolic, physiological, and immunological processes. Moreover, alterations in the composition of the intestinal microbiota can have a direct impact on the host's health.[3–5] Recent research has identified many bacterial species and analyzed their physiological roles in connection with specific diseases, such as type 2 diabetes mellitus, cardiovascular diseases, obesity, and cancer.[6–9] Additionally,

the misuse of broad-spectrum antibiotics can lead to an imbalance in the microbial ecosystem, potentially resulting in conditions like diarrhea and gastroenteritis.[10,11] This protective function of gut microbiota against pathogens is termed bacterial antagonism and competitive exclusion. The mechanisms by which normal intestinal flora inhibits pathogens include competition for nutrients and colonization sites, production of toxic substances, and stimulation of the immune system.[12] As a result, there is a growing interest in the human gut microbiota, recognizing its significant role in overall health.[13]

Probiotics are defined as live microbial supplements that beneficially affect the host's health by promoting a balanced intestinal microflora.[14] They have been studied as dietary supplements that can contribute positively to individual health.[15] The benefits of probiotics extend beyond the GIT to include alleviation of symptoms and reduction of complications associated with systemic metabolic disorders, such as type 2 diabetes mellitus and cardiovascular diseases.[16,17] Previous research has focused on the relationship between probiotics and immune-related conditions, including atopic dermatitis and inflammatory bowel diseases, highlighting the role of probiotics in modulating the host immune response.[18] Probiotics, such as Lactobacilli and bifidobacteria have been shown to traverse the intestinal mucous membrane and stimulate phagocytosis in organs such as the spleen for several days.[19,20] Recent studies indicate that probiotics may improve lipid profiles, reduce levels of plasma total cholesterol, low-density lipoproteins, and triglycerides, or increase high-density lipoproteins.[21,22]

Prebiotics, on the other hand, were initially defined as non-digestible food components that selectively stimulate the growth and/or activity of specific bacteria in the GIT, thereby improving human health.[23] Later, they were redefined as selectively fermented components that result in specific alterations in the composition and/or activity of the gut microbiota, offering benefits to the host's health and well-being.[24,25] In 2004, the definition was updated to include three specific criteria: i) resistance to gastric acidity, mammalian enzyme hydrolysis, and gastrointestinal absorption; ii) fermentation by intestinal microbiota; and iii) selective stimulation of the growth and/or activity of intestinal bacteria related to health benefits.[23] Currently, prebiotics that meet these criteria include fructo-oligosaccharides, lactulose, and galacto-oligosaccharides.[26] All prebiotics have a bifidogenic effect, meaning they are metabolized by bifidobacteria and promote their colonization in the gut. This, in turn, helps to maintain GIT homeostasis and prevents the growth of harmful pathogens.[27–29] Moreover, prebiotics can locally boost the production of vitamin B3, act as antiadhesive agents,[30] and promote the formation of short-chain fatty acids, which may reduce blood ammonia levels, decrease glucagon, improve glucose tolerance, and increase insulin sensitivity.[31,32] Thus, the administration of prebiotics may play a regulatory role in metabolic diseases.

Synbiotics are combined products containing both probiotics and prebiotics.[33] Each probiotic and prebiotic influence the gut microbiota in its own way, which suggests that various combinations of these products warrant further study. Investigating such combinations is important, as they could lead to more versatile therapeutic strategies, improving patient compliance and reducing healthcare costs.[34,35]

To our knowledge, there is a lack of studies assessing the awareness of Palestinian Healthcare Professionals (PHCPs) regarding these concepts in Palestine. Therefore, the aim of this study is to evaluate the awareness and knowledge of Palestinian healthcare professionals (physicians and pharmacists) concerning probiotics, prebiotics, and synbiotics.

Materials and Methods

A cross-sectional study was conducted from July 2017 to March 2018 across various healthcare facilities in the West Bank, Palestine. The study included hospitals, clinics, and community pharmacies located in Hebron, Bethlehem, Ramallah, Jerusalem, Nablus, Jenin, Tubas, Qalqilya, Tulkarm, and Jericho. All hospitals visited were government-operated, while clinics were private, and pharmacies were community-based. Annual reports from associations of pharmacists and physicians were used to gather data on the number and distribution of Palestinian doctors and pharmacists. At the time, the West Bank had a total of 5,000 physicians and 4,050 pharmacists.

The sample size, comprising 369 physicians and pharmacists, was calculated using the Raosoft sample size calculator with a 5% margin of error, a 95% confidence level, and an assumed response rate of 95%. To ensure accuracy and compensate for potential non-responses, the sample size was increased by 5%. The sample included 200 physicians and 169 pharmacists, proportionally selected based on the distribution of healthcare professionals throughout the West Bank and further stratified by city using a quota sampling method. The study included participants who had been practicing for at least one year, excluding dentists and Ear, Nose, and Throat (ENT) specialists.

A custom-developed questionnaire, validated through a pilot study with a sample of 30 participants, was used to ensure reliability and clarity of the items. The first part gathered socio-demographic details such as age, gender, residency type (village, city, or camp), and professional specialty. The second part consisted of 15 questions, each with at least two answer choices and an option for participants to provide their own responses if none of the choices were suitable.

The study included physicians and pharmacists practicing in the West Bank for at least one year, with dentists and ENT specialists excluded. A total of 369 participants met the inclusion criteria and were invited to take part in the study. Most participants were interviewed face-to-face, while some were interviewed over the phone. The interviews were conducted by pharmacy students from An-Najah National University. The study protocol was approved by the Institutional Review Board (IRB) at AN-Najah National University (IRB/17/S32). In addition, a verbal consent from each doctor and pharmacist was obtained before enrolling them in the study. Data was analyzed using SPSS (version 21, IBM, Armonk, NY, USA). Continuous variables were presented as means±Standard Deviation (SD) or medians (IQR), and categorical data as frequencies and percentages. Chi-square test assessed differences, with $p<0.05$ indicating significance.

Results

In this study, the demographic characteristics of the participants, including age, gender, and place of residence, were examined to understand their background and potential influences on their awareness and perceptions of probiotics, prebiotics, and synbiotics (Table 1). Among the 200 physicians surveyed, 25% were between the ages of 23 and 29, 29% were aged 30-39, 29.5% were 40-49, and 16.5% were 50 and older. In contrast, the 169 pharmacists were younger on average, with a majority (56.8%) aged 23-29, followed by 20.7% in the 30-39 age range, 13.6% in the 40-49 range, and 8.9% aged 50 and above. Gender distribution differed notably between the two groups. Among physicians, 64% were men and 36% were women, while pharmacists showed a reversed pattern

with 39% men and 61% women participants (Table 1). Regarding place of residence, most participants in both groups resided in cities or villages, with 49.5% of physicians and 50.2% of pharmacists living in cities, and 44% of physicians and 40.2% of pharmacists living in villages. A smaller percentage (6.5% of physicians and 9.6% of pharmacists) resided in refugee camps (Table 1).

Table 2 compares the frequency with which physicians and pharmacists recommend or use probiotics. Pharmacists more frequently advocate for daily use (20.7%) compared to physicians (7.5%), with a significant p value of 0.03. Physicians slightly favor weekly recommendations, with 11.5% doing so versus 9.5% of pharmacists (p = 0.023). The groups are similar in recommending probiotics several times per month, at 19.5% for physicians and 17.8% for pharmacists (p = 0.029). Both groups predominantly recommend probiotics following antibiotic treatments, with 35% of physicians and 36% of pharmacists endorsing this frequency (p = 0.037). Additionally, 9.5% in each group recommends probiotics depending on patient condition (p = 0.023). Notably, physicians (17%) are more likely than pharmacists (6.5%) to be uncertain about recommendation frequency (p = 0.02). This analysis reveals a tendency among pharmacists toward more frequent, daily probiotic advocacy, while physicians slightly favor weekly recommendations or express greater uncertainty in their approach.

The knowledge regarding the benefits of probiotics among physicians and pharmacists is illustrated in Table 3. Both groups show relatively similar levels of knowledge, with 4% of physicians and 4.7% of pharmacists acknowledging probiotics as a means to reduce bloating, while 12.5% of physicians and 9.5% of pharmacists recognize their role in improving digestive health. A small percentage of physicians (1.5%) and pharmacists (0.6%) note benefits in preventing constipation. Additionally, 14% of physicians and 12% of pharmacists identify a combination of these benefits (reducing bloating, improving digestive health, and preventing constipation). Only 2% of physicians and 0.6% of pharmacists associate probiotics with weight loss, and 11.5% of physicians versus 3% of pharmacists believe probiotics support the immune system. While none of the physicians' attribute heartburn relief to probiotics, 0.6% of pharmacists do it. Notably, a significant portion of pharmacists (59%) reported knowledge of all these benefits, compared to 30.5% of physicians. Conversely, 24% of physicians were uncertain of the benefits, compared to 10% of pharmacists. The p value for each category indicates no significant difference in knowledge between the two groups. Overall, pharmacists appear slightly more comprehen-

Table 1. Sociodemographic characteristics of Palestinian healthcare providers involved in the study.

Characteristics	Pharmacists (%)	Physicians (%)
Age		
23-29 year	96 (56.8)	50 (25)
30-39 year	35 (20.7)	58 (29)
40-49 year	23 (13.6)	59 (29.5)
50 and over	15 (8.9)	32 (16.5)
Total	169	200
Gender		
Man	66 (39)	128 (64)
Woman	102 (61)	73 (36)
Total	169	200
Living place		
City	85 (50.2)	99 (49.5)
Village	68 (40.2)	88 (44)
Refugee camp	16 (9.6)	13 (6.5)
Total	169	200

Table 2. Frequency of recommending probiotic use.

Frequency	Physicians (%)	Pharmacists (%)	P value
Every day	15 (7.5)	35 (20.7)	0.03
Once a weak	23 (11.5)	16 (9.5)	0.023
Several time per month	39 (19.5)	30 (17.8)	0.029
Only after antibiotics	70 (35)	61 (36)	0.037
Depending on patient's condition	19 (9.5)	16 (9.5)	0.023
Unknown	34 (17)	11 (6.5)	0.02
Total	200	169	

Table 3. Knowledge about the benefits of using probiotics according to physicians and pharmacists.

Benefits	Physicians (%)	Pharmacists (%)	P value
Reduce bloating (1)	8 (4)	8 (4.7)	0.1
Improve digestive health (2)	25 (12.5)	16 (9.5)	0.1
Prevent constipation (3)	3 (1.5)	1 (0.6)	0.1
(1)+(2)+(3)	28 (14)	20 (12)	0.1
Helping in weight loss	4 (2)	1 (0.6)	0.1
Support immune system	23 (11.5)	5 (3)	0.1
Relieve heart burn	0 (0)	1 (0.6)	0.1
All of the above	61 (30.5)	100 (59)	0.1
Unknown	48 (24)	17 (10)	0.1
Total	200	169	

sive in their understanding of probiotics' benefits than physicians, especially in acknowledging a range of benefits.

The prescription of various commercial probiotic products by physicians and pharmacists shows differences in familiarity and usage patterns (Table 4). Among physicians, 15% recommend Acidophilus compared to 10% of pharmacists (p=0.207), while 11% of physicians and 7.1% of pharmacists prescribe Hexbio (p=0.267). Probiotic Jamieson® is more frequently prescribed by physicians (16.5%) than pharmacists (5.3%), showing a statistically significant difference (p=0.001). Notably, 68% of pharmacists reported familiarity with all listed products (Acidophilus, Hexbio®, and Probiotic Jamieson®), a higher percentage than the 33% of physicians, also with statistical significance (p=0.001). However, 24% of physicians were uncertain about the specific products, compared to 9% of pharmacists (p=0.001). Some pharmacists (0.6%) are familiar with both Acidophilus and Hexbio®, while 0.5% of physicians are familiar with Acidophilus and Probiotic Jamieson®, though these differences are not statistically significant. Overall, the results suggest that pharmacists have a broader familiarity with a range of probiotic products than physicians.

The knowledge of healthcare professionals, specifically physicians and pharmacists, regarding foods rich in probiotics or prebiotics is outlined in Table 5. Among the foods listed, yogurt was the most recognized, with 31% of physicians and 34.7% of pharmacists identifying it as a source (p=0.109). Other foods such as milk were acknowledged by 6% of physicians and 3% of pharmacists, but without a statistically significant difference. Additionally, both groups showed limited recognition for other probiotic/prebiotic foods: 2% of physicians versus 1.6% of pharmacists recognized onion (p=0.491), and garlic was identified by 2.5% of physicians and 4.6% of pharmacists (p=0.873). A minor percentage of both groups correctly identified cereals, bananas, and combinations of foods such as milk and yogurt or milk, yogurt, and garlic. Only a small fraction (2.5% of physicians and 4.6% of pharmacists) identified all listed foods as probiotic or prebiotic sources (p=0.873). Notably, 26% of physicians and 14.6% of pharmacists were unaware of any foods containing probiotics or prebiotics, highlighting a significant knowledge gap overall (p=0.001). These findings indicate varying levels of awareness between the two groups, with limited familiarity beyond common items like yogurt.

Discussion

In recent years, there has been growing interest in the health benefits associated with probiotics and prebiotics, leading to a surge in research. Probiotics have shown promising effects in various clinical contexts, including the treatment of infectious diseases, diarrhea (both viral and antibiotic-associated), lowering cholesterol, and improving lactose digestion.[36,37] Some probiotic strains can also modulate the immune system, reduce symptoms in inflammatory bowel diseases, improve lactose intolerance, and potentially offer protective effects against specific cancers.[38] Given the wide range of possible health benefits, the present study aimed to evaluate the awareness and perceptions of probiotics, prebiotics, and synbiotics among healthcare professionals in Palestine.

Table 4. Prescription of commercial probiotic products by physicians and pharmacists.

Product	Physicians (%)	Pharmacists (%)	P value
Acidophilus (1)	30 (15)	17 (10)	0.207
Hexbio (2)	22 (11)	12 (7.1)	0.267
Probiotic Jamieson (3)	33 (16.5)	9 (5.3)	0.001
All of the above	66 (33)	115 (68)	0.001
Unknown	48 (24)	15 (9)	0.001
1,2	0 (0)	1 (0.6)	0.933
1,3	1 (0.5)	0 (0)	1.0
Total	200	169	

Table 5. Knowledge of Palestinian healthcare providers about food products rich in probiotics and/or prebiotics.

Type of food	Physicians (%)	Pharmacists (%)	P value
Milk (1)	12 (6)	5 (3)	0.235
Yoghurt (2)	62 (31)	59 (34.7)	0.109
Onion (3)	4 (2)	3 (1.6)	0.491
Garlic (4)	5 (2.5)	8 (4.6)	0.873
Cereals (5)	4 (2)	4 (3.4)	0.524
Banana (6)	1 (0.5)	2 (1.2)	0.985
(1)+(2)	36 (18)	38 (22.5)	0.679
(1)+(2)+(4)	13 (6.5)	10 (5.7)	0.737
(3)+(4)	6 (3)	7 (4.1)	0.784
All of the above	5 (2.5)	8 (4.6)	0.873
Unknown	52 (26)	25 (14.6)	0.524
Total	200	169	

Previous studies indicate that consumer knowledge and attitudes toward probiotics vary. Early studies using focus groups found that consumers familiar with "friendly bacteria" in yogurt were more receptive to probiotics' health benefits, while those unfamiliar remained skeptical.[39,40] The current study underscores the need for healthcare providers to be well-informed, as they play a crucial role in educating patients. Globally, knowledge of probiotics among healthcare providers varies; in Nigeria, for example, providers showed limited awareness, which influenced their usage recommendations.[1] In contrast, in India, 93% of healthcare providers were familiar with probiotics, though only half correctly understood their health benefits.[41] This highlights a global variation in awareness, which can be influenced by training and resources.

Our study involved 369 Palestinian healthcare professionals (200 physicians and 169 pharmacists) who completed the questionnaire with high response rates. Sociodemographic differences, such as age and gender, influenced awareness levels. Most pharmacists were younger, suggesting they may have had more exposure to updated curricula on probiotics. Similarly, gender distribution varied, with most pharmacists being women, aligning with gender trends in Palestinian pharmacy education. Awareness of probiotics was higher among pharmacists (83.4%) than physicians (68.5%), with a statistically significant difference ($p=0.001$). Awareness of prebiotics and synbiotics was generally lower, indicating a need for broader education across healthcare professionals.

The GIT hosts a complex microbial ecosystem that plays crucial roles in nutrient production, infection prevention, and immune modulation.[3] Probiotics, prebiotics, and synbiotics help maintain a healthy balance within this ecosystem, which is vital for overall health.[36] As functional foods, they are available in various forms, including fermented foods and pharmaceutical products.[34] Clinical studies report positive outcomes of probiotic use for gastrointestinal disorders like irritable and inflammatory bowel disease, *Helicobacter pylori* infection, and allergic conditions.[1] Additionally, probiotics have shown potential in treating obesity, diabetes, liver disease, and certain cancers, emphasizing their importance in preventive and therapeutic applications.[42,43]

Our findings suggest that, while many healthcare professionals recognize the value of probiotics, knowledge about specific benefits and appropriate dosing remains limited. In our study, 35% of both physicians and pharmacists recommended probiotics after antibiotic use, while fewer advised usage based on individual health conditions (9.5%). Probiotic usage recommendations varied between daily, weekly, or only after antibiotics, with a statistically significant difference between groups ($p<0.05$). This variation reflects an overall gap in standardized guidelines, suggesting a need for educational programs to improve understanding of probiotic dosing and benefits.

In summary, this study reveals gaps in knowledge and awareness among Palestinian healthcare professionals regarding probiotics, prebiotics, and synbiotics. Pharmacists showed higher awareness than physicians, possibly due to recent educational trends. Given the growing use of probiotics, increasing awareness among healthcare providers is crucial for delivering accurate recommendations to patients. Educational initiatives such as seminars, workshops, and professional development programs are essential for enhancing healthcare providers' understanding, ultimately benefiting public health.

This study has several limitations, notably its reliance on self-reported data, which could be prone to bias or inaccuracies concerning healthcare professionals' knowledge and views about probiotics, prebiotics, and synbiotics. Although the sample size was sufficient, it might not accurately reflect the range of opinions among all healthcare professionals in Palestine, especially in less-represented areas like refugee camps. The cross-sectional design of the survey also restricts the ability to establish causal relationships regarding awareness and attitudes toward these products. Differences in the educational backgrounds and training among healthcare professionals may influence their comprehension and application of probiotic practices. Moreover, cultural and situational factors that could affect perceptions of probiotics were not investigated in this study. Finally, the results may have limited generalizability to other countries or regions, as local healthcare policies and educational systems can vary significantly and impact knowledge and practices.

Conclusions

Healthcare professionals demonstrated a limited understanding and awareness of probiotics, with their knowledge of prebiotics and synbiotics being almost negligible, leading to these topics not being analyzed alongside probiotics. Given the importance of these products, it is essential to improve healthcare professionals' awareness and knowledge about probiotics and functional foods that promote health. This can be achieved through educational initiatives like workshops, lectures, and continuous professional training. Additionally, pharmaceutical and nutraceutical companies should prioritize educating healthcare professionals over solely using marketing tactics to promote these products. Investment by local pharmaceutical companies in producing such items could also help bolster the local economy, which is impacted by the ongoing Israeli military occupation.

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