PANEVĖŽIO KOLEGIJA ISSN 2029-1280, eISSN 2669-0071. Taikomieji tyrimai studijose ir praktikoje – Applied Research in Studies and Practice, 2025, 21.

PROBIOTIC CONSUMPTION PATTERNS AND AWARENESS ABOUT BENEFICIAL AND HARMFUL HEALTH EFFECTS AMONG BIOMEDICAL STUDENTS

Asta BUTKUVIENĖ

Panevėžio kolegija/State Higher Education Institution, Lithuania

Abstract. Probiotic supplements are widely recognized for their potential health benefits, yet their adverse effects are often overlooked. Recent evidence highlights several health risks associated with probiotics, underscoring the need for greater awareness and careful use. This study aimed to analyze patterns of probiotic supplement consumption among biomedical students and assess their awareness of both beneficial and harmful health effects. The study was conducted from February to September 2025, focusing on students' knowledge of probiotic-rich foods and microorganism species, motivations for supplement use, duration of consumption, attitudes toward safety and compatibility, experienced effects, and knowledge of contraindications. Findings indicate a general lack of knowledge among students regarding probiotic-containing foods and the composition of probiotic supplements, with most able to identify only the most common foods and strains. The primary motivation for supplementation was antibiotic use, particularly for managing diarrhea, followed by poor digestion and constipation. More than half of respondents reported using probiotics only once, with typical use lasting approximately two weeks. Most participants obtained probiotics based on medical advice, predominantly from pharmacies. Positive effects, including improved digestion, bowel function, immunity, and skin condition, were commonly reported, whereas adverse effects—primarily bloating and flatulence—were reported by one-third of participants. Awareness of serious adverse effects and contraindications was limited; only a minority recognized risks associated with immunocompromised individuals, premature neonates, or other vulnerable populations. These results highlight significant gaps in knowledge regarding both the benefits and risks of probiotics among biomedical students, emphasizing the need for targeted educational interventions to promote safe and informed use of probiotic supplements.

Keywords: probiotic supplements, beneficial and harmful health effects, contraindications

INTRODUCTION

The probiotic supplements have long been associated with many health benefits, but their side effects, whether mild or severe, are often neglected or overshadowed by the enormous volume of information describing their beneficial effects. Recent evidence has demonstrated several health risks of probiotics that warrant serious reconsideration of their application and further investigations. Most microorganisms, like bacteria and yeast, are harmful, but probiotics are beneficial exceptions that contain helpful bacteria or yeast similar to those in the gut. Common types—such as *Lactobacillus, Bifidobacterium, and Saccharomyces Boulardii* support digestion, immunity, and overall health, though they may cause side effects in some people. Strains of *Bifidobacterium, Enterococcus, Lactobacillus, Saccharomyces Boulardii, and Escherichia coli Nissle 1917* are the most widely used probiotic bacteria. However, other strains such as *Lactococcus, Leuconostoc, Pediococcus,* and *Streptococcus* are also used as probiotics (Plaza-Diaz et al., 2019). Specific strains of probiotics, such as *L. Rhamnosus* GG and B. animalis, could serve as adjuvant therapies for T2DM management (Ayesha et al., 2023). Probiotics have long been associated with many health benefits, but their adverse effects whether mild or severe, are often neglected or overshadowed by the enormous volume of information describing their beneficial effects. Apart from strain composition and probiotic product formulation, specific individual differences (age, specific health condition, genetic factors and differences in the composition of the gut microbiome) might play a role in the efficacy of probiotics (Agamennone et al., 2018). Recent evidence has demonstrated several health risks of probiotics that warrant serious reconsideration of their application and further investigations. Probiotics are tolerable for most people. However, some might experience unpleasant or uncomfortable gastrointestinal problems lasting for a few weeks. The symptoms may include temporary gas, bloating, stomach pain, constipation and diarrhea (Doron & Snydman, 2015). Some probiotic strains can cause a histamine reaction in the digestive tract. Histamine allergic reactions may cause watery eyes, stuffy noses, minor skin rashes, swelling and itchy skin. Certain types of probiotic bacteria produce histamine, but other strains naturally reduce histamine levels. Most probiotic supplements contain a combination of these bacteria and do not significantly affect histamine levels in the body. However, individuals sensitive to histamine or those with histamine intolerance should exercise caution when taking probiotics. Some histamine-producing probiotic strains include *Lactobacillus buchneri, Lactobacillus helveticus, Lactobacillus hilgardii, Streptococcus thermophilus* (Hrubisko et al., 2021). Like other medications, probiotics may contain some ingredients that can trigger an allergic reaction in some people, for instance, many probiotics contain lactose, so individuals who are lactose intolerant should avoid taking them. Others contain yeast, so people with yeast allergy should take bacteria-based probiotics (Castellazzi et al., 2013). Biogenic compounds (compounds produced or derived from living organisms) include histamine, tyramine, tryptamine, and phenylethylamine. Biogenic amines naturally develop during fermentation and can affect the central nervous system,

causing headaches (Pessione & Cirrincione, 2016). A weak immune system is more prone to infections. In rare cases, probiotic bacteria or yeast enter the bloodstream and may cause an infection. A review of different studies finds that children and adults with severe diseases or compromised immune systems should avoid probiotics. While still rare, the infection risk from taking probiotics is higher in people taking immunosuppressant medications, with prolonged stay in hospital or ICU, with a venous catheter, who have had recent surgeries (Doron & Snydman, 2015). Although rare, probiotic bacteria can contain antibiotic-resistant genes. There is a risk that these genes may be transmitted to other strains of bacteria, including those that cause harmful infections (Agamennone et al., 2018). To reduce the risk of consuming antibiotic-resistant bacteria, probiotics must be purchased from pharmacies or other trusted, reputable sources. Probiotics are the elements that provide an effective strategy to prevent or ameliorate many diseases. The one critically important factor to consider is that probiotics used for disease should be strain-specific unless otherwise stated in guidelines (Sen, 2019). However, future research should obtain evidence regarding the optimal dose for each individual strain and the most effective matrix. Future studies should also determine whether probiotic strains, be them ancient or of the new generation, colonize our intestines, or they are simply transitory microorganisms with beneficial effects (Maftei et al., 2024).

The object of the study: Patterns of probiotic supplement consumption among the students of biomedical sciences and awareness about beneficial and harmful health effects

Objective of the study: to analyze patterns of probiotic supplement consumption among the students of biomedical sciences and awareness about beneficial and harmful health effects

Tasks of the study:

1. To assess awareness of probiotic-rich foods and microorganisms, classified as probiotics.
2. To reveal the motivation for taking probiotic supplements.
3. To estimate the duration of taking probiotic supplements, attitudes to safety and compatibility.
4. To reveal the beneficial and harmful effects.
5. To evaluate the knowledge about contraindications to probiotic supplements.

THE RESEARCH METHOD

The quantitative method was chosen for the study. The questionnaire based on findings of the newest scientific literature was created including demographic and specific subsections with questions mapping directly the tasks of the study. The online survey was conducted between February-September 2025, respondents were second-year and third-year students of biomedical sciences, who had consumed probiotic supplements at least once and had given consent to participate. First-year students were not recruited because they had not yet undertaken specific coursework related to probiotics and their effects during their initial academic year. In total, 94 respondents participated in the online survey. Ethical standards were followed throughout the study to ensure the privacy and confidentiality of all participants. Respondents were assured that their participation was voluntary, and that their responses would be anonymized and used solely for the purposes of the research. The final analysis included data from 91 questionnaires, as three participants had filled the questionnaire incorrectly and were therefore excluded. The survey enrolled 94 respondents, the data obtained and analysed from 91 questionnaires. Data was processed and analyzed using Microsoft Office Excel.

THE RESULTS AND DISCUSSION

The demographic data (n=91) revealed that the majority of respondents were females. The predominant age range of the participants was between 21 and 50 years, the bigger part being 31-40 years of age. A significant portion of the sample were second-year students, and the majority reported being simultaneously employed and enrolled as students (see Table 1):

Table 1

The demographic data

The gender, %		**The age, %**	
Female	**97**	18-20 years	14
Male	3	21-30 years	**22**
The social position, %		31-40 years	**35**
Student and employee	**80**	41-50 years	**21**
Student	18	51-60 years	8
On maternity leave	2		
Second-year student	**69**		
Third-year student	31		

Regarding the health condition and lifestyle, the results revealed that the majority of respondents were healthy, more than half reported being active physically and sporty, one-fifth stated losing weight. A smaller proportion indicated adherence to specific diets, including vegan or vegetarian (see Figure 1):

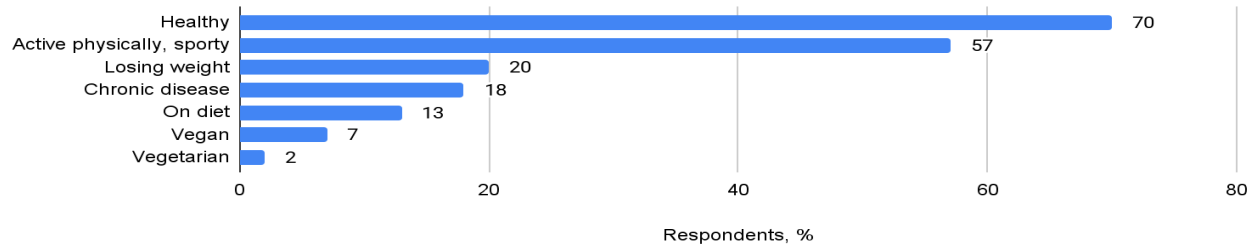

Figure 1. **The health and lifestyle**

According to Sen (2019), yoghurt is a dairy product produced by bacterial fermentation of milk using a culture of *Lactobacillus bulgaricus and Streptococcus salivarius subsp. Thermophiles* bacteria. Probiotic-rich cheeses often feature words such as "live culture," "active culture" or "probiotics" on the packaging. Today, commercial cultured buttermilk is produced from cow's milk using either Streptococcus lactis. The findings of the study indicate that the majority of respondents were familiar with kefir, yogurt, buttermilk, and sauerkraut as foods rich in probiotics. Fewer than half recognized cottage cheese as a source of probiotics, while approximately one-third were aware that kombucha, kimchi, certain fermented vegetables, and infant formula may contain specific probiotic strains. Only a small proportion of participants identified fermented soy products and miso paste as probiotic-rich foods. Overall, the results suggest that participants primarily associated probiotics with the most commonly known food products (see Figure 2):

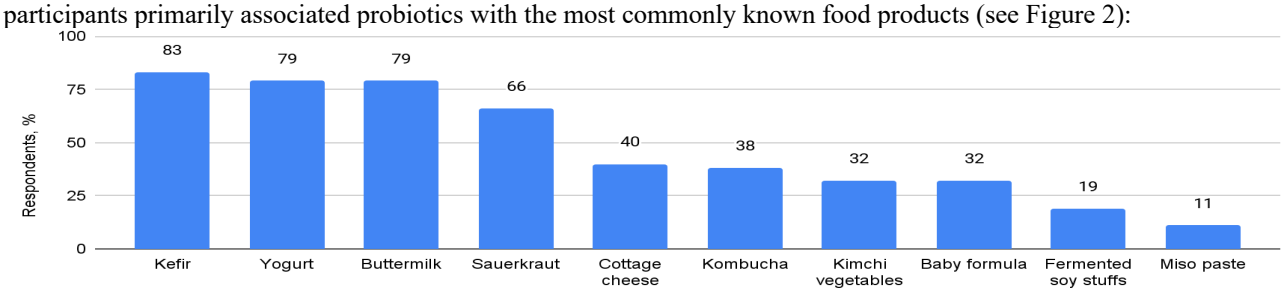

Figure 2. **The probiotic rich foods**

Kombucha is a Chinese tangy/sweet "mushroom tea." The yeast component of kombucha may contain *Saccharomyces cerevisiae, Brettanomyces Bruxellensis, or Candida Stellata*. Sauerkraut is the ancient art of culturing, fermenting and pickling vegetables that dates back thousands of years. The Korean version is known as "kimchee." The vegetable fermentations contain four species of lactic acid bacteria, *Leuconostoc mesenteroides, Lactobacillus plantarum, Pediococcus Pentosaceus*, and *Lactobacillus brevis* (Sen, 2019). Different types of probiotics have different functions, and human health benefits have mainly been demonstrated for specific probiotic strains. Several genera are used as probiotics, including *Lactobacillus*, *Bifidobacterium*, *Bacillus*, *Pediococcus*, and several yeasts (Talib et al., 2019). The findings of the study indicated that while most respondents recognized *Lactobacillus* and *Bifidobacterium* strains as probiotics, the majority were not familiar with other probiotic microorganisms such as *Escherichia coli* Nissle 1917, *Bacillus subtilis*, *Streptococcus salivarius*, *Enterococcus faecalis*, or the yeast *Saccharomyces Boulardii*. These results highlight significant gaps in participants' knowledge regarding the range of microorganisms classified as probiotics, see Table 2:

Table 2

The microorganisms classified as probiotics

The Microorganisms	Agree, %	Don't know, %	Disagree, %
Only bacteria	**57**	13	30
Bacteria and fungi	35	**40**	**25**
Saccharomyces Boulardii	13	**77**	**10**
Lactobaccilus	**66**	33	1
Bifidobacterium	**78**	22	-
Streptococcus salivarius	7	**35**	**58**
Enterococcus faecalis	11	**44**	**45**
Bacillus subtilis	2	**59**	**39**

The Microorganisms	Agree, %	Don't know, %	Disagree, %
Only bacteria	**57**	13	30
Bacteria and fungi	35	**40**	**25**
Saccharomyces Boulardii	13	**77**	**10**
Escherichia coli Nissle 1917	-	**55**	**45**
Clostridium difficile	-	57	43
Staphylococcus	-	46	54
Candida albicans	-	59	41

Long-term probiotic supplementation led to changes in serum biochemical parameters; systemic pro-inflammatory response confirmed by increased serum and tissue inflammatory cytokines; enlargement of lymphoid aggregates in the colon; and finally changes in faecal microbial composition. Short-term probiotic administration resulted in positive changes in the percentage of blood innate and specific immune cells (Hradicka et al., 2023). Typically, the duration of a probiotic course ranges from one to three months, depending on the clinical indications. The results of the study revealed that the majority of students had consumed probiotic supplements for approximately two weeks. More than half of the respondents reported using probiotics only once, about one-third had taken them a few times, and a smaller proportion had used them for periods ranging from four to five weeks up to six months. Only a minority of participants reported continuous consumption. Overall, the findings indicate that the most common duration of probiotic supplementation among students was two weeks, see Figure 3:

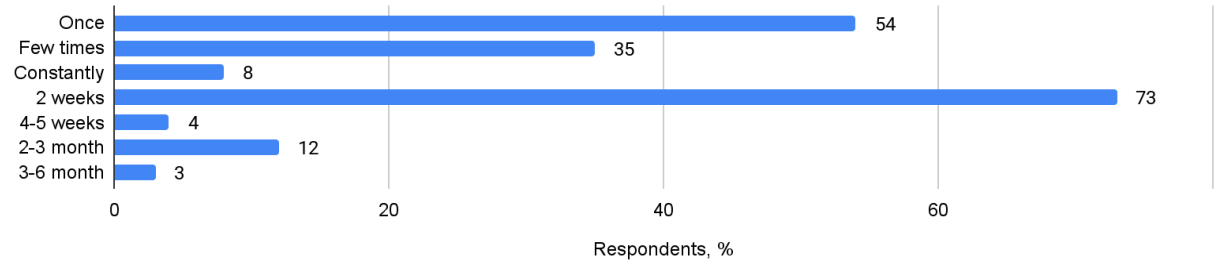

Figure 3. **The consumption and duration of course**

Analysis of the consumption patterns and indications for probiotic supplement use revealed that the majority of respondents reported taking probiotics both during and after an antibiotic course. Most participants adhered to the recommended dosage and used a single probiotic preparation. However, the majority did not verify the composition of the supplements and tended to select the least expensive products available. More than half of the respondents reported using probiotic supplements for the management of diarrhea, fewer than half-for symptoms of poor digestion, and approximately one-fifth for the relief of constipation, see Figure 4.

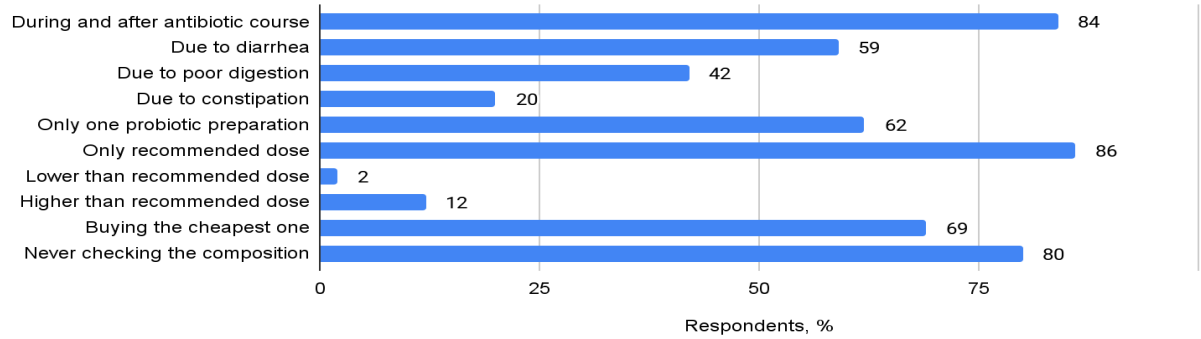

Figure 4. **The consumption patterns and indications**

Analysis of purchasing behaviors for probiotic supplements indicated that the majority of respondents consistently purchased probiotics when prescribed antibiotics, primarily obtaining them from pharmacies, where pharmacists routinely recommended their use. Approximately two-thirds of participants reported purchasing probiotic supplements following a physician's recommendation, while fewer than half reported acquiring probiotics through online sources, see Figure 5:

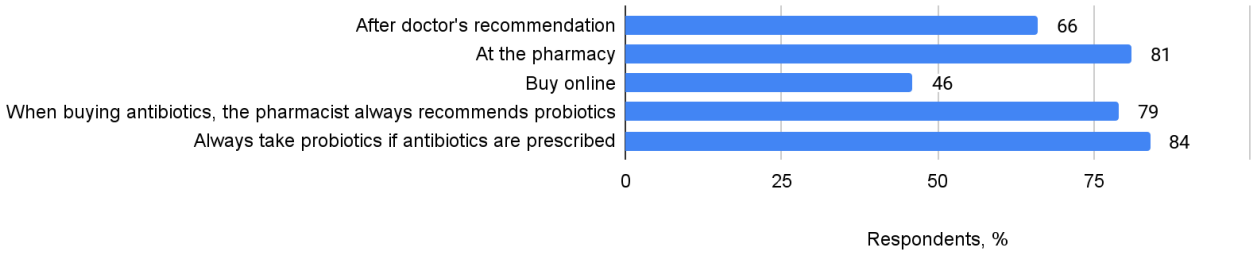

Figure 5. **The ways to purchase probiotic supplements**

There is sufficient evidence to make a recommendation for the use of specific probiotic products for the prevention of antibiotic associated diarrhea (Agamennone et al., 2018). The administration of probiotics has also been used in the treatment of acne as adjunctive therapy (Maftei et al., 2024). Recent studies have provided direct and indirect evidence to demonstrate that gut microbiota plays a critical role in the pathogenesis of migraine (Crawford et al., 2022). In the present study, the majority of respondents reported positive health effects associated with probiotic use, including improved digestion and bowel regularity. Approximately half of the respondents reported enhanced immunity, while around one-third noted improvements in skin condition and increased energy levels. Conversely, more than one-third of participants reported adverse effects, with flatulence and diarrhea being the most commonly reported, see Figure 6:

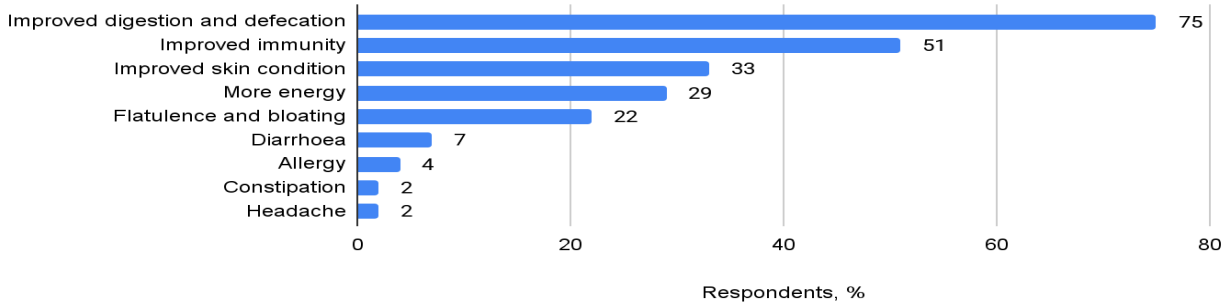

Figure 6. **The positive and negative health effects**

The individuals under neonatal stages and/or those with some clinical conditions including malignancies, leaky gut, post-organ transplant convalescence likely fail to reap the benefits of probiotics. Further exacerbating the conditions, some probiotic strains might take advantage of the weak immunity in these vulnerable groups and turn into opportunistic pathogens engendering life-threatening pneumonia, endocarditis, and sepsis (Kothari, Patel, & Kim, 2019). Probiotic bacteria have the ability to harbor intrinsic and mobile genetic elements that confer resistance to a wide variety of antibiotics. High amounts of probiotics in dietary supplements can establish a reservoir of antibiotic-resistant genes in the human gut and transfer to pathogens that share the same intestinal habitat (Talib et al., 2019). The findings suggest that incorporating probiotics into T2DM management strategies could offer potential benefits in terms of glycaemic control, insulin sensitivity, and inflammation reduction (Ayesha et al., 2023). The results of the present study indicate that knowledge of the more severe side effects of probiotic supplements was limited, with fewer than half of respondents being aware of them. Approximately one-quarter of participants identified allergic reactions or sensitization as potential severe effects, while a smaller proportion recognized the risk of antibiotic resistance, fungal infections, autoimmune disease, endocarditis, or sepsis. A small number of respondents incorrectly reported increased glycemia as a severe side effect. Overall, these findings highlight substantial gaps in knowledge regarding the serious health risks associated with probiotic supplement use (see Figure 7).

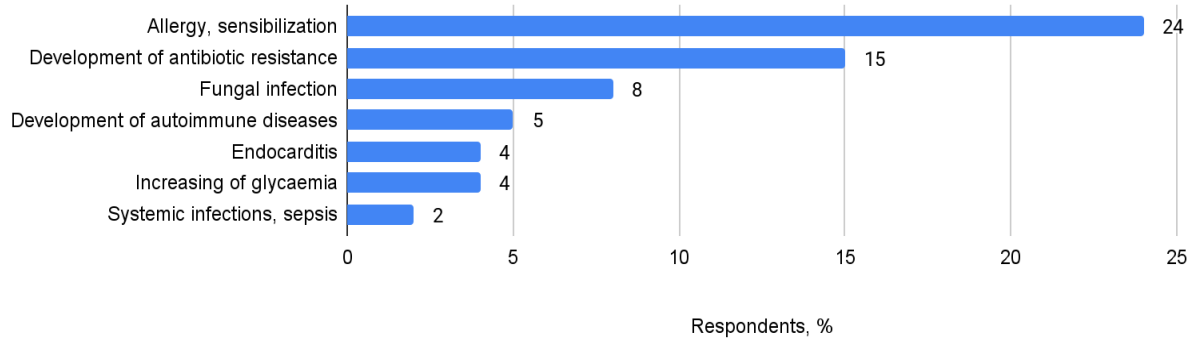

Figure 7. **The more severe side effects**

Regarding the contraindications of probiotic supplements, the results indicate that fewer than half of respondents recognized premature infants as a population for which probiotics may be contraindicated. One-third identified newborns and infants, and one-quarter cited hyperglycemia in type 2 diabetes mellitus, although some responses reflected incorrect

assumptions. One-third of participants indicated inflammatory bowel disease as a contraindication, while one-quarter recognized that probiotic use may be contraindicated in patients in intensive care units of all ages, including premature infants, individuals with compromised immunity, those with open wounds, and patients with pancreatitis (see Figure 8). Overall, these findings highlight substantial gaps in knowledge regarding the contraindications of probiotic supplements:

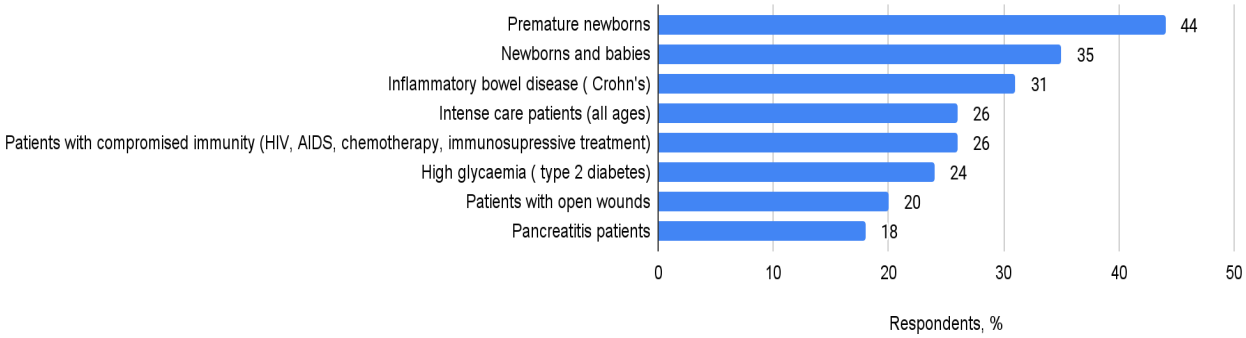

Figure 8. **The contraindications**

Analysis of the consumption patterns and indications for probiotic supplement use revealed that the majority of respondents were taking probiotics both during and after an antibiotic course. Most participants adhered to the recommended dosage and used a single probiotic preparation, but did not verify the composition of the supplements and tended to select the least expensive products available. More than half of the respondents reported using probiotic supplements for the management of diarrhea, fewer than half for symptoms of poor digestion, and approximately one-fifth for the relief of constipation. Analysis of purchasing behaviors indicated that most respondents consistently purchased probiotics when prescribed antibiotics, primarily obtaining them from pharmacies, where pharmacists routinely recommended their use. Approximately two-thirds of participants reported purchasing probiotic supplements following a physician's recommendation, while fewer than half reported acquiring probiotics through online sources.The majority of respondents reported positive health effects associated with probiotic use, including improved digestion and bowel regularity. Approximately half of the respondents reported enhanced immunity, while around one-third noted improvements in skin condition and increased energy levels. Conversely, more than one-third of participants reported adverse effects, with flatulence and diarrhea being the most commonly reported. The results indicate that knowledge of the more severe side effects of probiotic supplements was limited, with fewer than half of respondents being aware of them. Approximately one-quarter of participants identified allergic reactions or sensitization as potential severe effects, while a smaller proportion recognized the risk of antibiotic resistance, fungal infections, autoimmune disease, endocarditis, or sepsis. A small number of respondents incorrectly reported increased glycemia as a severe side effect. Overall, these findings highlight substantial gaps in knowledge regarding the serious health risks associated with probiotic supplement use. Regarding the contraindications of probiotic supplements, fewer than half of respondents recognized premature infants as a population for which probiotics may be contraindicated. Approximately one-third identified newborns and infants, and one-quarter cited hyperglycemia in type 2 diabetes mellitus, although some responses reflected incorrect assumptions. One-third of participants indicated inflammatory bowel disease as a contraindication, while one-quarter recognized that probiotic use may be contraindicated in patients of all ages, including premature infants in intensive care units, individuals with compromised immunity, those with open wounds, and patients with pancreatitis. The increasing availability of probiotic supplements, aggressive media advertising, and common beliefs that these substances have only positive effects on health indicate a need for continuous monitoring of this phenomenon. It is advisable to include specific courses or lectures covering the indications, contraindications, interactions, and potential adverse effects of probiotic supplements in health care study programs. As scientific knowledge about this topic is bound to increase in the coming years, so organization of continuous medical education courses for clinicians and therapists should be encouraged.

CONCLUSIONS

1. The findings indicate a general lack of knowledge among students regarding probiotic-containing food products and the composition of probiotic supplements. Most respondents could name only the most commonly known probiotic foods and strains.

2. The primary motivation for probiotic supplementation was antibiotic use, with the majority taking probiotics during or after an antibiotic course. Over half of the respondents cited diarrhea as the main indication, followed by poor digestion (less than half), and constipation (one-fifth).

3. More than half of the participants reported using probiotic preparations only once, while one-third had used them occasionally, and a minority reported regular use. The typical duration of use was two weeks. Approximately two-thirds of respondents stated they purchased probiotics based on a doctor's recommendation and preferred to obtain them from pharmacies.

4. The majority of respondents reported improvements in digestion and bowel movements. Half noted

enhanced immunity, and one-third observed improvements in skin condition. Adverse effects were reported by one-third of participants, most commonly bloating and flatulence. Knowledge of serious adverse effects such as fungal infections, antibiotic resistance, sepsis, endocarditis, autoimmune reactions, or effects on glycaemic control was limited. Only one-quarter of respondents mentioned allergy or sensitization as potential severe side effects.

5. One-third of respondents identified Crohn's disease as a contraindication, and one-quarter were aware of risks for patients in intensive care or those with compromised immunity. Fewer respondents identified contraindications related to surgical patients, open wounds, or pancreatitis. Notably, less than half of the respondents stated that probiotic supplements are contraindicated in premature neonates, one-third - in neonates and babies, one-quarter incorrectly identified hyperglycemia as a contraindication, indicating significant gaps in knowledge regarding the safe use of probiotics.

REFERENCES

Agamennone, V., Krul, C. A. M., Rijkers, G., & Kort, R. (2018). A practical guide for probiotics applied to the case of antibiotic-associated diarrhea in The Netherlands. *BMC gastroenterology*, *18*(1), 103. https://doi.org/10.1186/s12876-018-0831-x

Ayesha, I. E., Monson, N. R., Klair, N., Patel, U., Saxena, A., Patel, D., & Venugopal, S. (2023). Probiotics and Their Role in the Management of Type 2 Diabetes Mellitus (Short-Term Versus Long-Term Effect): A Systematic Review and Meta-Analysis. *Cureus*, *15*(10), e46741. https://doi.org/10.7759/cureus.46741

Castellazzi, A. M., Valsecchi, C., Caimmi, S., Licari, A., Marseglia, A., Leoni, M. C., Caimmi, D., Miraglia del Giudice, M., Leonardi, S., La Rosa, M., & Marseglia, G. L. (2013). Probiotics and food allergy. *Italian journal of pediatrics*, *39*, 47. https://doi.org/10.1186/1824-7288-39-47

Crawford, J., Liu, S., & Tao, F. (2022). Gut microbiota and migraine. *Neurobiology of pain (Cambridge, Mass.)*, *11*, 100090. https://doi.org/10.1016/j.ynpai.2022.100090

Doron, S., & Snydman, D. R. (2015). Risk and safety of probiotics. *Clinical Infectious Diseases, 60*(Suppl_2), S129–S134. https://doi.org/10.1093/cid/civ085

Hradicka, P., Adamkova, P., Lenhardt, L., Gancarcikova, S., Farkasova Iannaccone, S., & Demeckova, V. (2023). *Addressing safety concerns of long-term probiotic use: In vivo evidence from a rat model. Journal of Functional Foods, 104,* 105521. https://doi.org/10.1016/j.jff.2023.105521

Hrubisko, M., Danis, R., Huorka, M., & Wawruch, M. (2021). Histamine Intolerance-The More We Know the Less We Know. A Review. *Nutrients*, *13*(7), 2228. https://doi.org/10.3390/nu13072228

Kothari, D., Patel, S., & Kim, S.-K. (2019). Probiotic supplements might not be universally effective and safe: A review. *Biomedicine & Pharmacotherapy, 111*, 537–547. https://doi.org/10.1016/j.biopha.2018.12.104

Maftei, N.-M., Raileanu, C. R., Balta, A. A., Ambrose, L., Boev, M., Marin, D. B., & Lisa, E. L. (2024). The Potential Impact of Probiotics on Human Health: An Update on Their Health-Promoting Properties. *Microorganisms*, *12*(2), 234. https://doi.org/10.3390/microorganisms12020234

Pessione, E., & Cirrincione, S. (2016). Bioactive Molecules Released in Food by Lactic Acid Bacteria: Encrypted Peptides and Biogenic Amines. *Frontiers in microbiology*, *7*, 876. https://doi.org/10.3389/fmicb.2016.00876

Plaza-Diaz, J., Ruiz-Ojeda, F. J., Gil-Campos, M., & Gil, A. (2019). Mechanisms of Action of Probiotics. *Advances in nutrition (Bethesda, Md.)*, *10*(suppl_1), S49–S66. https://doi.org/10.1093/advances/nmy063

Sen, M. (2019). *Role of probiotics in health and disease—A review. International Journal of Advanced Life Science Research, 2*(2), 1–11. https://doi.org/10.31632/ijalsr.2019v02i02.001

Talib, N., Mohamad, N. E., Yeap, S. K., Hussin, Y., Aziz, M. N. M., Masarudin, M. J., Sharifuddin, S. A., Hui, Y. W., Ho, C. L., & Alitheen, N. B. (2019). Isolation and characterization of *Lactobacillus* spp. from kefir samples in Malaysia. *Molecules, 24*(14), 2606. https://doi.org/10.3390/molecules24142606

