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ORIGINAL ARTICLE

KNOWLEDGE AND PERCEPTIONS OF PROBIOTICS AMONG MEDICAL AND DIETETICS STUDENTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background. The gut microbiota plays a key role in human health, and probiotics represent one of the main strategies for its modulation. Knowledge of probiotics among medical and dietetics students may influence their future clinical practice.
Objective. To compare the knowledge and perceptions of probiotics among medical and dietetics students.
Material and Methods. A cross-sectional study was conducted among 107 students of the Medical University of Bialystok (55 medical students, 52 dietetics students). A 34-item questionnaire was used (maximum score: 51 points). Analyses included the *Chi*-square test and the Mann-Whitney U test; $p < 0.05$ was considered significant.
Results. Dietetics students achieved a higher overall score than medical students (median: 31 vs. 27 points; $p = 0.005$). They more often correctly identified the definition of probiotics (94% vs. 69%; $p = 0.002$), appropriate product labeling (77% vs. 44%; $p < 0.001$), and distinguished fermented foods from probiotics (65% vs. 20%; $p < 0.001$). Differences were also observed regarding strain specificity (65% vs. 22%; $p < 0.001$), SIBO (75% vs. 42%; $p < 0.001$), and selected clinical indications, including IBS, atopic dermatitis, acne, ulcerative colitis, and upper respiratory tract infections. Medical students more frequently reported recommending probiotics to others (73% vs. 48%; $p = 0.009$).
Conclusions. The overall level of knowledge was low, with dietetics students outperforming medical students in key areas. The findings suggest a potential need for enhanced evidence-based education on probiotics at the Medical University of Bialystok.

Keywords: *knowledge, perception, probiotics, medical students, dietetics students, cross-sectional study*

INTRODUCTION

The human gut microbiota constitutes a highly complex ecosystem that plays a crucial role in maintaining the host homeostasis. An imbalance of the intestinal microbiota, known as dysbiosis, may manifest through various symptoms, such as an altered ratio of beneficial to pathogenic microorganisms, changes in microbial metabolism, bacterial translocation, or small intestinal bacterial overgrowth (SIBO) [1]. Dysbiosis has been observed in the course of numerous gastrointestinal disorders as well as extraintestinal conditions, including type 2 diabetes, obesity, chronic liver diseases, and neuropsychiatric disorders [2].

One of the fundamental approaches to modulating the gut microbiota is the use of probiotics, defined by the WHO as live microorganisms which, when administered in adequate amounts, confer a health benefit on the host [3]. There is high-quality evidence supporting the efficacy of probiotics in, among others, the prevention of antibiotic-associated diarrhea, treatment of acute infectious diarrhea, irritable bowel syndrome, ulcerative colitis, and as an adjunct to *Helicobacter pylori* eradication therapy [4]. Moreover, an increasing number of studies highlight their therapeutic potential in metabolic, dermatological, and psychiatric diseases [5, 6].

Physicians and dietitians are two medical professions that most frequently recommend probiotic supplementation to their patients for various reasons. It is therefore essential that they possess adequate knowledge regarding the use of probiotics. However, existing studies suggest that the level of knowledge among healthcare professionals is generally moderate, while their self-reported confidence in applying probiotic therapy varies considerably [7-11]. Particularly limited data are available concerning students of medical disciplines, although it is during their studies that the foundations of future clinical practice are formed. The few studies comparing students of medical-related disciplines (including medicine and dietetics) indicate significant differences in knowledge levels, which may translate into their

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subsequent clinical decision-making [12-15]. The aim of the present study was to assess and compare the knowledge and perceptions of probiotics among medical and dietetics students.

MATERIALS AND METHODS

Study group

A total of 107 students from the Medical University of Bialystok participated in the study, including medical (n = 55) and dietetics (n = 52) students. Inclusion criteria comprised being a student of the medical or dietetics program at the Medical University of Bialystok. No formal exclusion criteria were applied. Sociodemographic data collected included gender, field of study, and year of study. Data on participants' age were not collected; the study group was described by year of study. Other sociodemographic factors were not included in the analysis; the comparison was limited to the field of study (medicine vs. dietetics). The study was conducted between June 2021 and June 2022.

Questionnaire and study procedure

A self-designed questionnaire consisting of 34 closed-ended single- and multiple-choice questions was administered in both electronic and paper formats. Among dietetics students, approximately half of the questionnaires were collected in person during university classes and half via online distribution, while the vast majority of medical students completed the survey electronically. Participation was voluntary and anonymous, and completion of the questionnaire was considered equivalent to providing informed consent. The items addressed sociodemographic data, general knowledge about probiotics, indications and contraindications for their use, tailoring probiotics to patients' needs, correct methods of administration, as well as individual experiences and perceptions of probiotics among respondents. Only items assessing factual knowledge about probiotics were scored. For single-choice questions, one point was awarded for each correct answer. For multiple-choice questions, participants received one point for indicating each correct option while avoiding incorrect ones. Some items were excluded from scoring due to the absence of a single unambiguously correct answer. Questions addressing personal experiences and perceptions of probiotics were not scored. The maximum achievable knowledge score was 51 points, with higher scores indicating greater knowledge. The questionnaire was developed based on a review of the scientific literature and previously published surveys assessing knowledge of probiotics. Its content validity was reviewed by the academic supervisor, an expert in dietetics; however, it was not formally validated.

Statistical analysis

Statistical analyses were performed using STATISTICA 13.3 (StatSoft, Poland). The *Chi*-square test of independence, the *Chi*-square test with Yates' correction, and the Mann-Whitney U test were applied. Results were considered statistically significant at $p < 0.05$.

Ethical considerations

The study was approved by the Bioethics Committee of the Medical University of Bialystok (approval no. APK.002.338.2021). The approval concerned exclusively the research described in this manuscript.

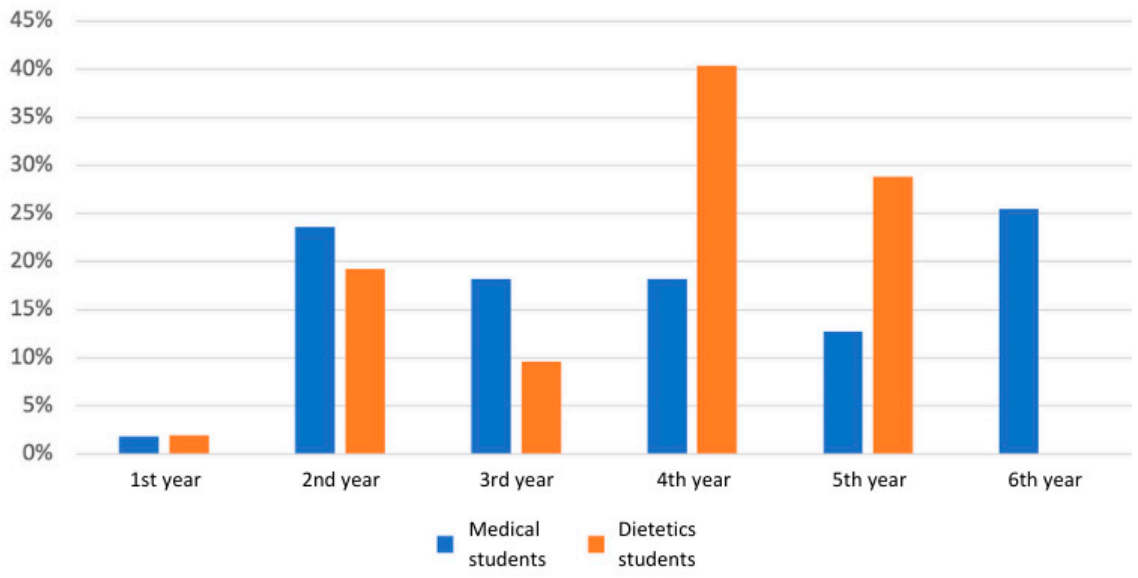

Figure 1. Distribution of medical and dietetics students by year of study (in %)

RESULTS

A total of 107 students from the Medical University of Bialystok participated in the study, including 89 women (83.2%) and 18 men (16.8%). The study group consisted of medical students (n = 55) and dietetics students (n = 52). Students from all years of both programs were included. The largest subgroups among dietetics students were from the 4th (40%) and 5th (29%) years, while the most numerous among medical students were from the 2nd (24%) and 6th (25%) years. The least numerous subgroup, for both programs, was 1st-year students (2%) (Figure 1).

Table 1 presents selected questions assessing general knowledge about probiotics. Dietetics students more frequently than medical students correctly identified the definition of probiotics and the proper labeling of probiotic preparations. Conversely, medical students were more likely to equate fermented foods with probiotics.

Table 2 presents selected questions assessing detailed knowledge about probiotics. A considerable proportion of respondents had difficulties in correctly evaluating the efficacy of multi-strain versus single-strain probiotic preparations. Dietetics students significantly more often indicated that the number of strains does not determine the effectiveness of a probiotic product. In the question on contraindications, dietetics students more frequently identified correctly that SIBO is not a contraindication to probiotic use. Conversely, medical students more often indicated that probiotics should not be administered to individuals with severe immunosuppression.

Table 3 presents selected questions on the use of probiotics in clinical practice. In both groups, the most frequently and accurately reported indication for probiotic use was antibiotic-associated diarrhea. Differences in favor of dietetics students were significant for several conditions, including irritable bowel syndrome (IBS), atopic dermatitis (AD), acne, ulcerative colitis (UC), and upper respiratory tract infections (URTI). Dietetics students were also more likely to recommend probiotic use for individuals on long-term nonsteroidal anti-inflammatory drug (NSAID) therapy, considering the potential for small intestinal mucosal injury.

Perceptions and experiences related to probiotics

The study also assessed students' perceptions of probiotics and their personal experiences. Medical students were significantly more likely than dietetics

Table 1. Selected questions assessing general knowledge about probiotics

Question (shortened)	Correct answers (%) Dietetics students (n = 52)	Correct answers (%) Medical students (n = 55)	p-value
Definition of probiotics: live microorganisms administered in adequate amounts that confer a health benefit	94	69	0.002
Labeling of probiotic preparations: the packaging should include information on the type, species, and strain	77	44	< 0.001
Fermented foods (e.g., kombucha, sauerkraut, kimchi): cannot be referred to as probiotics	65	20	< 0.001

p-values were determined using the *Chi*-square test or Yates' corrected *Chi*-square test, as appropriate

Table 2. Selected questions assessing detailed knowledge about probiotics

Question (shortened)	Correct answers (%) Dietetics students (n = 52)	Correct answers (%) Medical students (n = 55)	p-value
Is the purpose of probiotics to replace missing probiotic strains in the gut? – No	25	16	0.268
Are multi-strain preparations more effective than single-strain? – No	65	22	< 0.001
Are stool microbiota tests useful for selecting probiotics for patients? – No	12	9	0.677
Is SIBO a contraindication to probiotic use? – No	75	42	< 0.001
Should probiotics not be administered to individuals with severe immunosuppression? – Yes	31	69	< 0.001

p-values were determined using the *Chi*-square test or Yates' corrected *Chi*-square test, as appropriate

Table 3. Selected questions on the use of probiotics in clinical practice

Indication for probiotic use	Correct answers (%) Dietetics students (n = 52)	Correct answers (%) Medical students (n = 55)	p-value
Antibiotic-associated diarrhea	98	95	NA
Irritable bowel syndrome (IBS)	96	82	0.041
Atopic dermatitis (AD)	69	44	0.007
Acne	83	56	0.003
Ulcerative colitis (UC)	94	65	< 0.001
Upper respiratory tract infections (URTI)	58	36	0.027
Depression	71	64	0.407
Non-alcoholic fatty liver disease (NAFLD)	31	29	0.85
Infantile colic	62	53	0.357
Hyperlipidemia	52	38	0.153
Helicobacter pylori infection	73	60	0.151
Long-term NSAID use	71	36	< 0.001
Children in nurseries/kindergartens (infection prevention)	60	45	0.142
Cesarean delivery (prevention in newborns)	71	62	0.306

p-values were determined using the *Chi*-square test or Yates' corrected *Chi*-square test, as appropriate; NA – the test was not performed due to small sample sizes

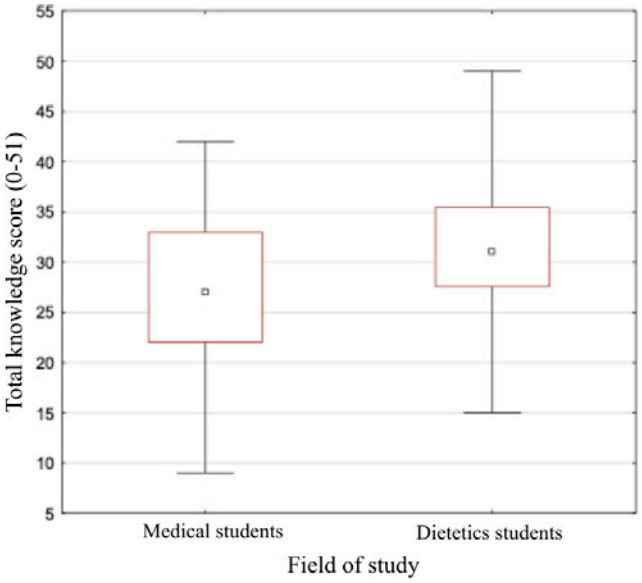

Figure 2. Total knowledge scores of dietetics and medical students (median, interquartile range, min-max)

students to recommend probiotic use to others (73% vs. 48%, p = 0.009). The main sources of knowledge about probiotics reported by both groups combined were the Internet (57%) and university (56.1%). The most frequently cited reasons for doubts regarding probiotic use included uncertainty about the quality of available probiotic products (39.3%) and insufficient knowledge (37.4%). The vast majority of students from both programs (medicine: 96%; dietetics: 90%) expressed willingness to further expand their knowledge on the role of probiotics in disease prevention and treatment.

Overall knowledge score

The total number of points obtained by dietetics students was significantly higher than in the group of medical students (median: 31 vs. 27 points, p = 0.005). Figure 2 presents the total scores achieved by dietetics and medical students.

DISCUSSION

In the present study, dietetics students achieved significantly higher overall knowledge scores on probiotics compared with medical students; however, the overall level of knowledge in both groups regarding the use of probiotics in disease prevention and treatment was assessed as low. In a cross-sectional study from 2024, only 37% of medical students and 48.5% of physicians demonstrated a good level of knowledge, while more than half of respondents identified lack of knowledge as the main barrier to the use of probiotics and prebiotics [8]. Similarly, among pharmacy and medical students, the majority rated their knowledge as fair or poor, and only advanced years of study were associated with better outcomes [13]. With regard to dietitians and dietetics students, it has been observed that although self-perceived knowledge is often rated highly, actual competencies are lower, and confidence in recommendations increases with education and clinical experience [14]. These observations are consistent with

the findings of the present study and underscore the need for systematic, evidence-based education.

Differences between students of the two study programs were particularly pronounced in questions concerning the definition of probiotics, the principles of proper labeling of probiotic products, and the understanding of strain specificity. Knowledge of the correct definition of probiotics and of the criteria a microbial strain must meet to be classified as a probiotic appears essential in the context of recommending their use in disease prevention and treatment. The results of this study show that some students – particularly those in medicine - fail to recognize the importance of strain designation on probiotic product labels. Such simplification (assuming that genus and species are sufficient) may lead to inappropriate recommendations in clinical practice, since probiotic properties are strictly strain-dependent [16]. Similar observations were reported by Ababneh Mera et al., where only 66.8% of physicians and pharmacists were aware of the importance of strain specificity in probiotics [17].

Another common misconception revealed in the study was the identification of fermented foods as probiotics. In this regard, dietetics students demonstrated greater knowledge, providing the correct response more than three times as often as medical students. In practice, although certain bacterial strains present in fermented foods may meet the criteria for probiotics, it is not possible to determine which microorganisms and in what quantities are present in a given food product [18]. Therefore, referring to fermented foods as probiotics is a major error, as it may imply, for example, that probiotic supplementation during antibiotic therapy can be replaced by consuming kefir or sauerkraut.

Another example of differences in knowledge concerned the perceived effectiveness of multi-strain versus single-strain probiotic preparations. In the present study, medical students were more than four times as likely as dietetics students to incorrectly indicate that multi-strain probiotics are more effective than single-strain products. In fact, McFarland reviewed studies on this topic and demonstrated that, in most cases, multi-strain preparations were not significantly more effective than single-strain ones, rightly emphasizing that the choice of a probiotic should be based not on the number of strains in the product but on clinical evidence for a specific probiotic strain [19]. It is also noteworthy that the vast majority of students in both groups incorrectly believed that stool microbiota testing may be useful for selecting probiotics for patients, which contradicts the current state of knowledge [20].

Significant differences also emerged regarding knowledge of clinical indications. The most commonly recognized indication was the prevention and treatment of antibiotic-associated diarrhea, which corresponds to the well-documented efficacy of probiotics in this area [21]. Dietetics students, more often than medical students, also identified other clinical conditions in which the role of probiotics is at least partially supported by the literature, such as IBS, atopic dermatitis, and ulcerative colitis. These differences are particularly important, as they concern disorders in which awareness of strain specificity and the limitations of evidence is crucial for appropriate clinical decision-making. Conversely, the incorrect perception of SIBO as a contraindication to probiotic use was more frequent among medical students, which contradicts findings from meta-analyses indicating the potential efficacy of probiotics in reducing symptoms and bacterial overgrowth [22, 23].

It is also worth noting students' attitudes toward probiotics. Medical students more frequently than dietetics students reported recommending their use to others, which may stem from the perceived role of physicians as the primary source of health advice. Different findings were reported by Johnson et al., where practicing dietitians were slightly more likely than family physicians to recommend probiotics to patients (91.2% vs. 78%) [11]. At the same time, in the present study both groups identified the Internet and academic classes as their main sources of knowledge about probiotics, while the most commonly reported concerns were related to the quality of available probiotic products and insufficient knowledge. These findings are consistent with observations of other authors, who emphasize that lack of knowledge and insufficient university-level education represent the main barriers to the use of prebiotics and probiotics among students [8, 13].

A major strength of the study is the direct comparison of two groups of students with different educational profiles, using a uniform questionnaire. Limitations include its single-center design, relatively small sample size, and cross-sectional nature, which does not allow for the assessment of changes in students' knowledge over time.

The findings of this study, together with available literature data, highlight the need for changes in the education of dietetics and medical students regarding probiotics. Particular attention should be given to the definition of probiotics, strain specificity, and practical clinical indications.

CONCLUSIONS

The level of knowledge about probiotics among medical and dietetics students at the Medical University of Bialystok was low, indicating a potential need for enhanced educational content in this area.

Dietetics students at the Medical University of Bialystok demonstrate a higher level of knowledge regarding the use of probiotics in disease prevention and treatment compared with medical students. This difference pertains to the understanding of the term "probiotic", recognition of fermented foods, awareness of strain specificity, factors determining probiotic efficacy, and knowledge of their applications in selected clinical conditions.

Students in both programs show a positive attitude toward probiotics and express willingness to further expand their knowledge in this field.

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Conflicts of interest

The author declares no conflict of interest.

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