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NUTRITIONAL KNOWLEDGE AMONG PROSPECTIVE HEALTHCARE PROFESSIONALS

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Unhealthy eating habits and a lack of physical activity are well-known risk factors for chronic illnesses, and many countries in transition have struggled to make progress in addressing diet-related non-communicable diseases. Education on diet and nutrition plays a crucial role in public health, and healthcare professionals are essential in promoting healthy eating habits. However, many healthcare providers feel insufficiently prepared to offer such guidance due to inadequate nutrition education and training during medical studies.

This research aimed to assess nutritional knowledge among pharmacy and medical students in south-eastern Serbia. A cross-sectional survey was conducted among undergraduate pharmacy and medicine students in the fall of 2022. The instrument for data collection was a questionnaire composed of 16 questions with multiple-choice questions about the role of specific nutrients, with only one correct answer per question. Nutritional knowledge was assessed based on the percentage of correct answers and classified as excellent (65-100%), moderate (45-64.9%), or poor (less than 45%). A total of 379 undergraduate students of pharmacy (n = 151) and medicine (n = 228) completed the survey. The majority of participants had poor nutritional knowledge, with an average score of 44.86%. The knowledge level varied significantly by study group ($p = 0.039$) and year of study ($p < 0.001$). Only 1.85% of students reported having quite good nutritional knowledge.

These findings indicate multiple deficiencies in the nutrition knowledge of medical and pharmacy students. As students' nutritional knowledge requires improvement, the development of specific programs that promote healthy lifestyle behaviors among students is strongly recommended. Additionally, medical students should receive more comprehensive, curriculum-based instruction in nutrition.

Keywords: nutrition, students, higher education, health sciences, questionnaire

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INTRODUCTION

Inadequate eating habits and physical inactivity are well-established and important risk factors contributing to chronic diseases (1). Unfortunately, Serbia, a country in transition, has shown limited progress toward achieving the diet-related non-communicable disease targets (2-4). Most people in Serbia do not have healthy eating habits due to excessive animal fat and red meat consumption, and low intake of fish and seafood, whole grains, vegetables, and fruit. At present, Serbia is in a stage of transition where nutrition-related non-communicable diseases, including coronary heart disease, stroke, cancer, obesity, type 2 diabetes, and hypertension, are dominating adult morbidity and mortality and are very high or growing rapidly in prevalence. Among other measures, nutrition education could help reduce and better manage these health problems in the Serbian population. (5).

Healthcare workers play the most significant role in promoting healthy dietary patterns (6,7), and patients consider physicians among the most credible sources of nutrition information (8). However, most of them feel unqualified to discuss dietary recommendations with patients, which may be attributed to inadequate education and preparedness during their training at the faculty. The barriers to providing dietary counselling are a lack of time and competence, and a lack of knowledge and resources (9). Several studies suggest that well-educated medical students feel prepared to discuss specific dietary recommendations with patients (10,11), but globally, nutrition has been underrepresented in the curriculum of many medical schools (12-14).

The COVID-19 pandemic is expected to increase the risk of all forms of malnutrition, so it is very important to know and understand the recommendations for food intake. The role of competent health workers in providing nutrition advice is crucial (15).

Identifying weaknesses in nutrition knowledge among medical students may provide guidance to improve their nutrition practice in the future. Therefore, the aim of the present study was to assess the nutritional knowledge of pharmacy and medicine students in south-eastern Serbia.

METHODS

Research Design

A cross-sectional study was conducted on randomly selected medicine and pharmacy students recruited from the University of Niš Faculty of Medicine between November 1 and December 15, 2022. The sample size for the study was calculated assuming that we would receive a large effect size for two independent study groups, d = 0.08, α = 0.05, and a study power of 95.18%. Based on those parameters, each of the groups required at least 42 subjects. The sample size calculation was performed in G*Power 3.1.9.2.

Study population

A total of 379 undergraduate pharmacy (n = 151) and medicine (n = 228) students in the 2nd to 4th years completed the survey. The criteria for inclusion in the study included a willingness to participate voluntarily in the study, being 2nd-4th year students, and not having passed the advanced nutrition course in the teaching curriculum. The exclusion criterion was the failure to complete the questionnaire anonymously. Before data collection, the participants received information about the objective of the study and signed the written consent form. The informed consent document explicitly informed potential participants that their responses had no bearing on academic performance.

The sample was stratified by study group, year of study, and sex.

Research instruments and data collection

The authors followed the latest version of the Declaration of Helsinki given by the World Medical Association, and the study protocol was approved by the Ethical Committee of the Public Health Institute Niš (No. 12-3785/5).

The study used a self-administered nutrition knowledge questionnaire, designed based on the report of Allaffi et al. (2012) and adjusted appropriately (16). The questionnaire was distributed during breaks from regular theoretical/practical lectures.

The questionnaire was pre-tested on ten students (5 males and 5 females) to assess comprehension of questions. The questionnaire (Supplementary data) was hand-delivered and contained 16 short questions about basic nutrition knowledge.

The first part of the questionnaire consisted of a short demographic form, and respondents were asked for their gender, height, weight, study group, and year of studies. Body mass index (BMI) was calculated using the values of weight (in kg) and height (in m) according to the student's statements.

The second section of the questionnaire consisted of 16 questions with multiple-choice answers, each of four possible answers (one correct), about the role of certain nutrients (Supplementary data). The answers were systemized according to the study program— Pharmacy or Medicine, and according to the year of study. All questions were equally weighted (incorrect or missing answer/correct answer).
Supplementary material is available at AFMN Biomedicine online.

Data analysis

The obtained data were systematized and processed in SPSS Statistical Software Package version 25.0. The basic sociodemographic characteristics of participants were estimated using descriptive statistics. Descriptive statistics are presented as frequencies, percentages, means, and standard deviations. Scores of the correct answers were calculated by summing the number of correct responses of all questions divided by the total questions multiplied by 100 to yield a percentage score. Nutritional knowledge was calculated as a percentage of correct responses and ranked as excellent 65-100%, moderate 45-64.9%, and poor < 45%. Differences in scores between study programs were examined using independent-samples t-tests, whereas differences across years of study were analyzed using one-way ANOVA followed by Duncan's post-hoc test. Statistical significance was defined as $p < 0.05$.

RESULTS

A total of 400 undergraduate medical students were recruited, and 379 valid questionnaires were received (response rate 94.75%).
The demographic data of the study participants are presented in Table 1.
Among 379 respondents, 151 were pharmacy students, and 228 were medicine students. A total of 99 were males (26.1%), aged between 20 to 23 years. Most students had a BMI within a normal range (18.5 to 24.99), and only 6 students were obese.
Among the 151 pharmacy students, 76 were in their 2nd year of study, and 75 were in their 3rd year of study. Of the 228 respondents, 35 were students of medicine in their 2nd year of study, 77 were in 3rd year of study, and 116 were in 4th year of study.
The average score for correctly answered questions in the overall sample was 44.86% (Table 2).

Table 1. *Socio-demographic data of students (N = 379)*

	Pharmacy students n (%)	Medicine students n (%)	Total N (%)
Age			
20	76 (50.3)	35 (15.4)	111 (29.3)
21	75(49.7)	77 (33.8)	152 (40.1)
22	-	116 (50.8)	116 (30.6)
Sex			
Female	121 (80.1)	159 (69.7)	280 (73.9)
Male	30 (19.9)	69 (30.3)	99 (26.1)
Body mass index (BMI)			
Less than 18.5	9 (6.0)	21 (9.2)	30 (7.9)
18.5 to 24.99	118 (78.2)	181(79.4)	299 (78.9)
25 to 29.99	23 (15.2)	21 (9.2)	44 (11.6)
30 and more	1 (0.7)	5 (2.2)	6 (1.6)

There were significant statistical differences in the average score between pharmacy students and students of medicine (averaging 44.77% vs. 44.11%, respectively, $p < 0.001$). Most students (more than 50%) gave the correct answer to eight questions, while poor knowledge was shown in the other eight questions. A statistically significant difference in the knowledge of Pharmacy and Medicine students in individual questions is also shown in Table 2.
Pharmacy students showed good knowledge of nutrients that can help prevent thrombosis, the relationship between protein intake and calcium metabolism, the usefulness of dietary fiber in lowering blood cholesterol levels, hydrogenated fats, and roles and sources of vitamins and minerals. Medicine students answered correctly a high percentage of the questions about the number of fat calories, deficiency of vitamin B1, and the preventive effects of fruits and vegetables on different types of cancer.
Regarding the percent of correct answers (Table 3), significant differences were found among students of different study years ($p < 0.001$) related to eight questions. The students of higher study years have been shown to have more nutritional knowledge.
The obtained results and statistical analysis showed the differences in nutrition knowledge between students of the second, third, and fourth years of Pharmacy and Medicine. The biggest differences exist among the fourth-year students, where pharmacy students showed better

nutrition knowledge than medicine students.

Differences in nutrition knowledge scores by different years of study and study programs are shown in Table 4. All groups had an almost equal mean percentage of correctly answered questions (the second year of study about 38%; the third year about 45% and the fourth year about 50%), but with statistically significant difference between pharmacy and medicine students in all three years ($p < 0.001$).

Most participants had poor nutritional knowledge—54.35% (23.79% of males, 76.21% of females). The proportion of participants with moderate nutritional knowledge was higher among males (68.07%) compared with females (31.93%). Only seven students (all female) were rated as excellent in their nutritional knowledge (Table 5).

Table 2. *Percentages of correct answers among pharmacy and medicine students (N = 379)*

	No. (%)	No. (%)		
	Overall	**Pharmacy students**	**Medicine students**	**p-value**
Q1.	243 (64.1)	83 (55)	160 (70.2)	**p < 0.001**
Q2.	159 (42)	70 (46.4)	89 (39)	**p = 0.019**
Q3.	105 (27.7)	46 (30.5)	59 (25.9)	p > 0.05
Q4.	132 (34.8)	54 (35.8)	78 (21.1)	p > 0.05
Q5.	75 (19.8)	27 (17.9)	48 (21.1)	p > 0.05
Q6.	206 (54.4)	94 (62.6)	112 (49.1)	**p < 0.001**
Q7.	216 (57)	94 (62.3)	122 (53.5)	**p = 0.001**
Q8.	116 (30.6)	40 (26.5)	76 (33.3)	**p = 0.004**
Q9.	152 (40.1)	68 (45)	84 (36.8)	**p = 0.007**
Q10.	38 (10)	12 (7.9)	26 (11.4)	**p = 0.027**
Q11.	191 (50.4)	72 (47.7)	119 (52.2)	p > 0.05
Q12.	182 (48)	69 (45.7)	113 (49.6)	p > 0.05
Q13.	198 (52.2)	70 (46.4)	128 (56.1)	p > 0.05
Q14.	221 (58.3)	103 (68.2)	118 (51.8)	**p < 0.001**
Q15.	208 (54.9)	69 (45.7)	139 (61)	**p = 0.027**
Q16.	278 (73.4)	110 (72.8)	168 (73.7)	p > 0.05
Average score for correctly answered questions (%)	44.86	44.77	44.11	**p < 0.001**

Based on the independent-samples t-test. Q1 – Q16: questions from the nutrition knowledge questionnaire.

DISCUSSION

To the best of our knowledge, this was the first study on the nutritional knowledge of medical students in Serbia. The response rate in the current study (94.75%) was much higher than reported by authors in similar studies (17,18) where the response rates were 36% and 40%, respectively.

We found that medical students had generally poor nutrition knowledge and the average score for correctly answered questions in the present study (44.86%) was slightly lower than observed in another survey of nutrition knowledge (49.6-57.14%) (18). Nutritional KAP (Knowledge Attitude and Practices) scores of Chinese students were significantly higher ($p < 0.05$) than international students (19). Medical students from Lisboa, Portugal, have a good baseline nutrition knowledge, which is evident in the fact that for each question at least 50% of the students gave the right answer (20).

Table 3. *Percentages (%) of correct answers among 2nd, 3rd and 4th year students (N = 379)*

	Overall	2nd Year Students	3rd Year Students	4th Year Students	p value
Q1.	243 (64.1)	54 (48.6)[a]	105 (69.1)[b]	84 (72.4)[b]	**p < 0.001**
Q2.	159 (42)	46 (41.1)[a]	59 (38.8)[a]	54 (46.6)[a]	p > 0.05
Q3.	105 (27.7)	41 (36.9)[a]	40 (26.3)[a,b]	24 (20.7)[b]	**p = 0.021**
Q4.	132 (34.8)	34 (30.6)[a]	55 (36.2)[a]	43 (37.1)[a]	p > 0.05
Q5.	75 (19.8)	15 (13.5)[a]	44 (28.9)[b]	16 (13.8)[a]	**p = 0.001**
Q6.	206 (54.4)	51 (45.9)[a]	79 (52)[a,b]	76 (65.5)[b]	**p = 0.009**
Q7.	216 (57)	62 (55.9)[a]	82 (53.9)[a]	72 (62.1)[a]	p > 0.05
Q8.	116 (30.6)	22 (19.8)[a]	49 (32.2)[a,b]	45 (38.8)[b]	**p = 0.007**
Q9.	152 (40.1)	45 (40.5)[a]	55 (36.2)[a]	52 (44.8)[a]	p > 0.05
Q10.	38 (10)	6 (5.4)[a]	15 (9.9)[a]	17 (14.7)[a]	p > 0.05
Q11.	191 (50.4)	49 (44.1)[a]	83 (54.6)[a]	59 (50.9)[a]	p > 0.05
Q12.	182 (48)	53 (47.7)[a]	69 (45.4)[a]	60 (51.7)[a]	p > 0.05
Q13.	198 (52.2)	39 (35.1)[a]	93 (61.2)[b]	66 (56.9)[b]	**p < 0.001**
Q14.	221 (58.3)	59 (53.2)[a]	90 (59.2)[a]	72 (62.1)[a]	p > 0.05
Q15.	208 (54.9)	44 (39.6)[a]	93 (61.2)[b]	71 (61.2)[b]	**p = 0.001**
Q16.	278 (73.4)	71 (64)[a]	110 (72.4)[a,b]	97 (83.6)[b]	**p = 0.003**

[a,b] Different letters indicate a significant difference in the knowledge of students in the second, third and fourth year of study, based on ANOVA test (Duncan post-hoc) ($p < 0.05$). Q1 – Q16: questions from the nutrition knowledge questionnaire.

Table 4. *Percentages (%) of correct answers to the nutrition knowledge questions among pharmacy and medicine students according to different year of study (N = 379)*

	2nd Year			3rd Year			4th Year		
	PS	MS	p-value	PS	MS	p-value	PS	MS	p-value
Average score for correctly answered questions (%)	38.88	38.96	**p < 0.001**	45.49	46.35	**p < 0.001**	51.48	47.21	**p < 0.001**

Based on the independent-samples t-test. Q1 – Q16: questions from the nutrition knowledge questionnaire. PS - Pharmacy Students, MS – Medicine Students

Table 5. *Average score for correctly answered questions*

Group	Gender	Poor (%)	Moderate (%)	Excellent (%)	Total (%)
Medical students	M F	36 88	36 65	0 4	72 157
Pharmacy students	M F	13 69	17 48	0 3	30 120
Total	379 (100%)	206 (54.35%)[a]	166 (43.8%)[a]	7 (1.85%)[b]	379 (100%) **p = 0.039**

[a,b] Different letters denote significant difference among students knowledge based on the ANOVA test (Duncan post-hoc) ($p < 0.05$)

The results of the survey conducted in 2017 at one University in Croatia showed that the students of pharmacy possessed greater knowledge regarding dietary supplementations than the students of medicine and dentistry ($p < 0.001$). The survey included 506 students that take the survey anonymously and thus showed their points of view and knowledge on dietary supplements. Pharmacists are those who mainly recommend supplements to patients and the patients themselves often address them for advice (21).

The research taken in California supports the recommendations that increased education of health workers on diet, in general, has a significant role in preventing and treating chronic diseases (22).

Trabucco and associates conducted a comparative study on the nutritional knowledge of medical students who practice sports across two European medical faculties. The questionnaire used in their research differed from the one employed in our study, and the statistically significant difference was observed between the groups regarding the sources from which students obtained their nutritional information (23).

The studies about nutrition knowledge and attitude mainly examine physicians and pharmacists (24-26). There is also a need to improve their nutritional knowledge in many countries, and the story should start from the beginning of education.

The results showed statistical significance in the knowledge of medicine and pharmacy students ($p < 0.001$). Pharmacy students had better knowledge about antioxidants ($p < 0.001$). Only 48% of students were familiar with the connection between cancer development and nutrition. As the students of both study groups will work with patients who need proper dietary advice and who need to know about the importance of certain nutrients for health and the prevention of many diseases, it is necessary to work on increasing the level of their knowledge. Good knowledge in these areas will provide greater security and confidence to future doctors and pharmacists when advising patients.

Despite the benefits of training, aware and informed healthcare workers for the delivery of evidence-based nutrition, the new curriculum will need to overcome some challenges in this field and the motivation for change.

A review of the literature on nutrition knowledge and attitudes among medical students produced many findings; however, existing studies considered specific and different types of questions (dietary supplements are most prevalent, whole grain consumption, surgery, aging, dietary sodium intake, sports nutrition, breastfeeding, and many more). The medical student population is considered one of the finest student populations, which are highly valued due to the position they take in society and the well-being of the people they counsel and treat (27-29).

This study has some limitations that must be noted. The generalizability of these results should be used carefully, i.e., results represent the perspectives of students from only one university in Serbia. Our further research could be focused on expanding the study to include a greater number of universities.

This study showed that most of the pharmacy and medicine students lacked nutritional knowledge. Nutrition and its outcomes should have more attention in the medical and pharmacy program curriculum in Serbia to provide better patient prevention and health care to future physicians and pharmacists.

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Statement of Ethics

This study protocol was reviewed and approved by the Ethical Committee of the Public Health Institute, Niš, approval number 12-3785/5-8.

Competing Interest

The authors declare no relevant conflicts of interest.

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