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Cancer and Cardiovascular Diseases Nutrition Knowledge and Dietary Intake of Medical Students

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A B S T R A C T

The aims of this study were to determine medical students' knowledge regarding the association between dietary factors and the risk of cancer and cardiovascular diseases and to investigate if this knowledge has an impact on their dietary intakes. Three hundred and ninety medical students (males and females) were included in a study and grouped according to their daily fibre and fat intakes. For diet – disease knowledge, questions from the General Nutrition Knowledge Questionnaire for Adults were used and dietary assessment was done with Food Frequency Questionnaire. The obtained results showed that the students' diet-disease knowledge was generally inadequate. Higher level of diet-disease knowledge was among those with high dietary fibre intake, with slightly better scores for dietary factors and risk for cardiovascular diseases than the risk for cancer. Better diet-disease knowledge positively correlated with higher intake of fish ($p=0.027$, $p=0.001$) and vegetables ($p=0.019$, $p=0.001$) in high fibre groups of both gender, and in females additionally with fruit intake ($p=0.038$, $p=0.007$). A higher dietary fibre intake among studied students seems to be a factor that ensures lower obesity rates, lower intake of energy and lower consumption of coffee, sweets and alcoholic drinks. On the basis of the results of this study, it is clear that medical schools should provide in their nutrition programs the opportunity for students to learn about their own dietary and lifestyle behaviours, in order to more knowledgably and convincingly counsel their future patients.

Key words: *medical students, diet-disease knowledge, fibre, fat, dietary intake*

Introduction

Nutrition is acknowledged to be of vital part of the health care system. However, the adequacy of nutrition education in undergraduate medical education is an issue of concern worldwide[1–4]. Patients routinely ask for physicians´ guidance about diet, considering them as experts that have adequate nutrition knowledge to be able to make appropriate dietary recommendations. Today's patient tends to be more egalitarian, informed, and demanding than patient two generations ago[5]. Since a healthy diet is one of main elements of health-protecting lifestyle, and the relation of nutrition to the prevention and treatment of disease is well known, it is of special concern for medical students to know and value that. Additionally, by adopting own healthy dietary habits, medical students in a perspective should serve as a trusted model in dietary counselling[6].

This generation of young adults has grown up with the benefit of current dietary recommendations to reduce fat intake and to adopt diet rich in dietary fibre, which are included in international recommendations[7] and also in Croatian nutrition policy[8]. Inadequate fibre and excess fat intake are one of the major health threatening factors. There is strong evidence that over-consumption of dietary fats over a period of time represents a very important component in the aetiology of diseases that are related to the cardiovascular system, cancer, or diseases of the digestive tract[9,10]. Additionally, several studies have established a positive association between the amount of fibre in diet and the prevalence or incidence of diseases such as diabetes[11], cardiovascular diseases[12], and colorectal cancer[13]. Consequently, for these non-communicable diseases dietary change is a part of

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the management and the physician's role is to know the principles of the recommended diet for major diseases and for general health and to provide up-to date concise dietary advices. In addition, outcome-based research on the amount, quality, and effectiveness of nutrition education is limited[2].

Cardiovascular diseases are the major causes of death in most European countries. Among these countries, standardised mortality from cardiovascular diseases is highest in Hungary (508 *per* 100,000 population) and Croatia (500/100,000) and lowest in Slovenia (295/100,000) and central European countries (238/100,000). In Croatia, cardiovascular diseases are the leading cause of death and accounts for more than half of overall mortality. Furthermore, cardiovascular mortality has been constantly rising since the 1970s[14]. Cancer ranks second as cause of death, participating with nearly 25% in mortality in Croatia. In 2005 Croatia's age-standardized rates using the standard European population yielded a mortality of 228/100,000, much higher than European countries (171/100,000)[15].

The mortality caused by cardiovascular diseases and cancer in the population can be significantly reduced by acquiring a healthier way of life such as non-smoking, proper diet and regular physical activity. It is well known that health promotion and primary prevention are of substantial importance in decreasing CVD and cancer mortality and morbidity[16].

In view of the above, the aims of this study were to determine medical students': 1) knowledge regarding dietary factors that can reduce the risk of cancer and cardiovascular diseases; 2) ability to identify particular food which could be recommended in prevention of mentioned diseases; 3) dietary intakes with the aim to investigate if this group with its dietary intakes could be a model for future patients; 4) correlation between particular nutrition knowledge and dietary intakes. As fat and fibre were applied as predictors of overall diet quality, students were divided into groups according to their fibre and fat intakes. A hypothesis was assumed that individuals with high fibre intake will be more knowledgeable and with practice of healthy diet principles that will be accepted by their future patients as more knowledgeable and convincing.

Subjects and Methods

Subjects

Three hundred and ninety medical university students of all study years from the University of Rijeka, Croatia participated in the study. After a presentation of the design of the study, all solicited students voluntarily chose to complete the questionnaires in classrooms. Students were classified according to criteria into 1 to 4 distinct groups of dietary fat and fibre intake, as follows: low fibre-moderate fat (LM); low fibre-high fat (LH); high fibre-moderate fat (HM); high fibre-high fat (HH). Low and high fibre intakes were defined, respectively, as less than 2.5g fibre/MJ, and 2.5g fibre/MJ and more. The fat intake was defined according to Acceptable Daily Macronutrient Range (AMDR), where moderate fat intake was defined as 20–35% of total energy intake, while high fat was defined as >35% total energy intake[17].

The study was performed as a part of a national project (as stated in Acknowledgements), which is, in all its parts, in compliance with all international and local laws, regulations and directions concerning the protection of examinees.

Survey instrument

A three-part, self-reported questionnaire consisted of: a section on demographic/anthropometric data, a dietary assessment record and a section on nutrition knowledge. Height and weight were self-reported, and body mass index (BMI) values were calculated as kg/m^2. For the definition of nutritive status, the categories of BMI defined by World Health Organization for adults older than 18 years were used[18].

Since the aim of this study was to examine students´ knowledge regarding dietary factors that can reduce the risk of cardiovascular diseases and cancer, a section of General Nutrition Knowledge Questionnaire for Adults[19], which is recently used in several studies[20,21], was applied. Because of its construction, this questionnaire could be used part by part. The answers were scored, each item carrying one point for a correct answer and the overall diet-disease knowledge score was 30 points. Student were asked to recognize dietary factors which can reduce the risk of cancer (maximum 6 points) and cardiovascular diseases (maximum 5 points) and identify fibre (maximum 10 points) and fat food sources (maximum 9 points).

The nutrients' intakes were assessed using the validated Food Frequency Questionnaire (FFQ), by which students noted their food consumption over past twelve months. The obtained data were converted into quantities using Croatian tables of chemical composition of foods and drinks[22,23]. Energy-adjusted values of dietary intake were calculated, and the provided values were compared with Dietary Reference Intakes (DRI), which are revised Recommended Dietary Allowances (RDA) and have been used in Croatia since 1994[24–26].

Statistical analysis

Descriptive statistics were given as $\overline{X}\pm$SD and absolute frequencies. Multifactorial two-way variance analysis (ANOVA) was used for multiple group comparison, followed by *post hoc* Scheffè test for significant differences. Correlations of dietetic parameters with nutrition knowledge were evaluated using Pearson's correlations. Differences between categorical variables were tested with χ^2-test. All statistic analyses were performed using STATISTICA, version 7.1[27]. Data were analysed separately to identify differences in gender responses. All analyses were considered statistically significant at $p<0.05$.

Results

Study population

Of the 410 students, that initially screened in this study, followed the exclusion of 20 participants due either to incorrectly fulfilled questionnaires or to a reported fat intake less than 20%MJ, so the entire study population consisted of 120 male and 270 female students, with an average age of 22 years (Table 1). The highest percentage of all students was in LH group (33.3%), while other groups distributed almost evenly. Although the majority of students could be considered as normal weight according to WHO classification[18], males had higher BMI than females. The BMI of the HH group was significantly the highest for males (p=0.003), reaching overweight, while females in that group had the significantly lowest BMI (p=0.001).

Students' nutrition knowledge on dietary factors that can reduce the risk of cancer, cardiovascular diseases and knowledge about dietary sources of fat and fibre

The section on dietary factors that can reduce the risk of cancer and cardiovascular diseases was generally well answered, with slightly better scores for identification of possible relationship between particular dietary factors and risk for cardiovascular diseases than the risk for cancer (Table 2). Just 16.4% of all students (more males (19.2%) than females (15.2%)) correctly answered all questions concerning dietary factors and cancer risk, while 32.8% of students correctly answered all questions about dietary factors and cardiovascular diseases (males more (40.0%) than females (29.6%)). Low fibre groups (LM and LH) scored better regarding nutrition knowledge on cancer risk, while high fibre groups (HM and HH) were more knowledgeable about dietary factors related to cardiovascular diseases (Table 2). Eighty five percent of respondents recognized the link between eating more fruits and vegetables and the reduced risk of cancer, while 78.7% knew that it could also reduce the chance of cardiovascular diseases. Ninety one percent of students correctly pointed out that reducing dietary saturated fat could help in the prevention of cardiovascular diseases (data not shown). However, 87.0% of students (females (88.1%) and males (84.2%)) knew that consuming more fibre could reduce the cancer risk and only 35.0% that it also can help in cardiovascular diseases diet therapy (males more (48.3%) than females (29.3%)).

The section dealing with student's ability to identify food rich in fat was generally better answered than the section concerning identification of sources of fibre. Females were more knowledgeable on those questions (57.0% of females had all correct answers *versus* 50.8% of males), although by both genders, mean values and SD were almost the same. For both genders better scores were obtained in high fibre groups (HH and HM). The major trap was the cottage cheese, for which the 66.8% of students failed to realize that is actually low in fat, with the majority of respondents classifying it into high fat food.

TABLE 1
MEDICAL STUDENTS' CHARACTERISTICS ACCORDING TO GENDER AND FIBRE/FAT INTAKE GROUPS (N=390)

Parameters	Fibre/fat intake groups				Total	p
	LM	LH	HM	HH		
N (%)	92 (23.6)	130 (33.3)	87 (22.3)	81 (20.8)	390 (100.0)	0.042*
Gender N (%)						
Males	41 (34.2)	41 (34.2)	18 (15.0)	20 (16.6)	120 (30.8)	0.789
Females	51 (18.9)	89 (32.9)	69 (25.6)	61 (22.6)	270 (69.2)	0.006**
Age (yrs)			$\overline{X}$±SD			
Males	22.1±2.6	22.3±2.2	20.8±2.1	21.8±2.0	21.9±2.3	0.142
Females	21.5±2.8	21.0±2.2	22.1±2.2	21.8±2.0	21.5±2.3	0.016[a,d]
Weight (kg)						
Males	79.8±11.0	82.4±9.1	82.6±10.2	90.1±16.3	82.8±11.8	0.013[a]
Females	64.2±8.8	60.3±7.9	62.7±8.2	59.4±8.1	61.5±8.4	0.006[c]
Height (m)						
Males	1.8±0.1	1.8±0.1	1.8±0.1	1.8±0.0	1.8±0.1	0.592
Females	1.7±0.1	1.7±0.1	1.7±0.0	1.7±0.1	1.7±0.1	0.814
Body mass index BMI (kg/m^2)						
Males	24.1±2.5	24.6±2.6	25.3±3.0	27.2±4.3	25.0±3.1	0.003[a,e]
Females	22.3±2.8	20.6±4.3	21.8±2.9	19.8±4.5	21.1±3.9	0.001[a,c,e]

*p<0.05 statistical significance by χ^2-test between fat/fibre intake groups
**p<0.05 statistical significance by χ^2-test between fat/fibre intake groups according to gender
Statistically significant differences established with ANOVA followed by post-hoc Scheffé test at p<0.05 with [a] differences LM *vs.* LH; [b] differences LM *vs.* HM; [c] differences LM *vs.* HH; [d] differences LH *vs.* HM; [e] differences LH *vs.* HH; [f] differences HM *vs.* HH

TABLE 2
MEDICAL STUDENTS' DIET-DISEASE NUTRITION KNOWLEDGE SCORES ACCORDING TO GENDER AND FIBRE/FAT INTAKE GROUPS (N=390) ($\bar{X}$±SD)

Parameters	Fibre/fat intake groups				Total	p
	LM	LH	HM	HH		
Nutrition knowledge score on dietary intakes that can reduce the risk of cancer (max 6 pt)						
Males	3.7±0.9	3.8±0.9	3.6±1.1	3.3±0.7	3.7±0.9	0.033[e]
Females	3.6±0.9	3.4±1.0	3.6±0.9	3.2±0.9	3.4±0.9	0.039[b]
Nutrition knowledge score on dietary intakes that can reduce the risk of cardiovascular diseases (max 5 pt)						
Males	3.2±0.8	3.3±0.7	3.4±1.0	3.5±0.7	3.3±0.8	0.041[e]
Females	3.0±0.6	3.1±0.6	3.4±0.8	3.3±0.6	3.2±0.7	0.041[c]
Nutrition knowledge score on dietary sources of fat (max 9 pt)						
Males	7.4±1.0	7.3±1.1	7.6±1.3	7.5±0.8	7.4±1.0	0.005[e]
Females	7.2±1.2	7.4±1.0	7.3±1.0	7.8±1.0	7.4±1.0	0.005[e]
Nutrition knowledge score on dietary sources of fibre (max 10 pt)						
Males	5.7±2.0	5.8±2.1	6.0±2.1	6.4±1.6	5.9±2.0	0.043[e]
Females	6.2±1.9	5.4±1.8	6.0±1.9	6.8±1.8	6.0±1.9	<0.001[e]
Overall Diet-disease knowledge score (max 30 pt)						
Males	20.0±2.8	20.2±3.3	20.5±3.6	20.7±2.3	20.3±3.0	0.049[e]
Females	19.9±2.5	19.3±2.8	20.2±3.0	21.1±2.7	20.1±2.8	0.002[e]

Statistically significant differences established with ANOVA followed by *post-hoc* Scheffé test at p<0.05 with [a] differences LM *vs.* LH; [b] differences LM *vs.* HM; [c] differences LM *vs.* HH; [d] differences LH *vs.* HM; [e] differences LH *vs.* HH; [f] differences HM *vs.* HH

To more than half of the questions regarding identification of fibre-rich food, 42.4% of males and 45.5% of females gave incorrect answers.

Overall diet-disease knowledge score on average reached 67.3% of the total score, where 28.3% males and 25.6% females correctly answered all questions. The participants with high fibre intake, of both genders had significantly better diet-disease knowledge than the participants with same fat intake (p<0.001; p=0.005), while LH group for females (p=0.002) had a significantly lower score (Table 2).

Students' dietary intakes

The results of daily dietary intakes of medical students according to gender and fibre/fat intake groups, taking into account macronutrients intake and intake of various food groups are summarized in Tables 3 and 4. Total daily energy intake was higher in males than in females, and was significantly the lowest in the HM group for both genders. The groups with high fibre intake had lower energy intake and lower energy density compared to low fibre groups. In the same fibre group, intake of proteins was higher in the groups that consumed more fat (LM *vs*. LH and HM *vs*. HH) (Table 3). The main sources of protein for low fibre groups were milk and meat, while for high fibre groups it were eggs and fish (Table 4). When study participants were asked about their habits in choosing low-fat dairy products, the highest percentage of fat-conscious participants of both genders belonged to the HM group (6.4% of males and 15.6% of females; p<0.001). The HM group had significantly the lowest energy share of total fat intake, such as the lowest intake of SFA, MUFA and PUFA (p<0.001) (Table 3). The males from these groups had significantly the lowest absolute intake of cholesterol such as the lowest cholesterol density (p<0.001). The HM group consisted of the highest portion of participants with intake of fat, SFA and PUFA within recommendations (26.5% of males and 17.9% of females meet the recommendations). The energy fraction of PUFA was significantly highest (p< 0.001) in the HH group for both genders as a consequence that this students were the best consumers of fish (Table 3 and 4). Statistically significant lower energy fraction of carbohydrates was found among students with lower fibre intake. On total, students had lower energy fraction of carbohydrates than recommended 50–60%. The dietary fibre density (g/MJ) was significantly higher in HM and HH groups than for low fibre groups for both genders (p<0.001). A comparison of fibre intakes with DRI for males and females showed that 96.0% of males and 47.2% of females had sub-optimal fibre intake. When the intakes of all analysed macronutrients were compared to AMDR, it could be noted that the HM group had the highest proportion (p<0.001) of participants with adequate dietary intakes according to gender (23.3% of males and 33.0% of females) (data not shown). Daily consumption of alcoholic beverages (mostly it was beer) and consequently, energy proportion of alcohol, was significantly the highest in the LM group and lowest in HH group for both genders (p<0.001, p=0.035) (Table 4). When the daily intake of food groups were analysed and comparison made in the light of high or low fibre consumption, it could be seen that students from both groups

TABLE 3
MEDICAL STUDENTS' DAILY ENERGY AND MACRONUTRIENT INTAKE ACCORDING TO GENDER AND FIBRE/FAT INTAKE GROUPS
(N=390) ($\bar{X}$±SD)

Parameters	Fibre/fat intake groups				Total	p
	LM	LH	HM	HH		
Energy (MJ)						
Males	11.2±4.0	12.8±5.8	10.2±2.5	10.8±2.6	11.5±4.4	0.048[e]
Females	10.2±2.2	10.3±2.4	9.8±2.4	10.0±2.6	10.1±2.4	0.035[e]
Energy (%DRI)						
Males	121.6±43.2	139.2±62.6	111.0±27.2	117.8±27.7	125.4±47.8	0.048[e]
Females	110.6±24.3	111.7±25.8	100.8±26.0	113.9±28.5	109.7±26.6	0.035[e]
Energy density (kJ/g)						
Males	3.1±0.9	3.6±1.4	2.8 ±1.3	3.0±0.7	3.0±1.1	0.042[e]
Females	2.8±0.9	3.1±1.2	2.6±0.9	2.6±1.2	2.8±1.1	0.013[e]
Proteins (%MJ)						
Males	14.1±2.4	15.0±1.7	15.1±1.3	15.9±1.5	14.8±2.0	0.007[f]
Females	14.2±2.4	14.3±2.1	13.5±1.6	14.5±1.9	14.1±2.1	0.063
Total fat (%MJ)						
Males	31.7±3.2	38.5±2.6	31.0±2.2	37.8±1.8	34.9±4.3	<0.001[a,d]
Females	33.2±1.8	39.1±3.8	31.5±3.1	38.4±3.4	35.8±4.7	<0.001[a,c,d]
Saturated fatty acids – SFA (%MJ)						
Males	13.9±2.5	15.4±2.0	12.2±2.3	14.5±2.6	13.9±2.6	<0.001[c,d,e]
Females	14.2±2.4	16.7±2.7	13.1±2.4	15.6±2.1	15.0±2.8	<0.001[c,d,e]
Monounsaturated fatty acids – MUFA (%MJ)						
Males	10.3±1.4	13.6±1.8	10.1±0.7	13.6±1.4	12.0±2.2	<0.001[a,c,d]
Females	11.2±1.2	13.3±2.3	10.2±1.6	12.9±1.8	12.0±2.3	<0.001[a,c,d]
Polyunsaturated fatty acids – PUFA (%MJ)						
Males	5.8±1.2	6.7±1.1	5.7±0.6	7.8±1.1	6.4±1.3	<0.001[a,c,d,f]
Females	5.9±1.2	6.5±1.7	6.8±1.4	7.8±2.2	6.7±1.8	<0.001[a,c,d,f]
Cholesterol (mg)						
Males	379.6±181.4	546.3±283.4	314.8±73.9	500.9±143.1	447.1±224.0	0.001[d]
Females	311.7±120.4	337.6±130.8	294.8±118.3	312.6±117.4	317.1±123.1	0.213
Cholesterol (%DRI)						
Males	126.5±60.5	182.1±94.5	104.9±24.6	167.0±47.7	149.0±74.7	0.001[d]
Females	103.9±40.1	112.5±43.6	104.2±39.1	98.3±39.4	105.7±41.0	0.213
Cholesterol (mg/4.184MJ)						
Males	141.3±48.7	180.5±66.5	130.7±20.0	192.2±40.1	161.6±56.3	<0.001[d]
Females	126.6±34.2	139.9±66.0	122.8±28.3	135.1±48.8	131.9±49.2	0.136
Carbohydrates (%MJ)						
Males	46.5±5.7	43.1±4.7	50.5±2.7	44.7±2.1	45.6±5.1	<0.001[a,b,d]
Females	50.1±5.2	45.3±5.7	52.7±4.6	46.4±5.4	48.4±6.1	<0.001[a,b,d]
Dietary fibre (g)						
Males	21.8±8.1	25.8±10.1	29.2±8.2	32.6±10.6	26.1±10.0	<0.001[c,d,e,f]
Females	22.1±5.4	20.5±6.2	33.7±11.1	27.0±7.2	25.6±9.5	<0.001[c,d,e,f]
Dietary fibre density (g/MJ)						
Males	2.0±0.3	2.0±0.3	3.0±0.3	2.9±0.3	2.2±0.5	<0.001[c,d,e,f]
Females	2.2±0.2	2.0±0.4	3.2±0.6	2.9±0.3	2.5±0.7	<0.001[c,d,e,f]
Dietary fibre (%DRI)						
Males	87.3±32.5	103.2±40.6	116.6±32.7	130.6±42.3	104.3±39.8	<0.001[c,d,e,f]
Females	88.4±21.7	82.1±24.8	134.6±44.4	107.9±28.7	102.4±37.8	<0.001[c,d,e,f]
Alcohol (%MJ)						
Males	8.0±9.0	3.5±3.3	2.7±3.9	1.6±1.1	4.6±6.3	<0.001[a,b,c]
Females	2.4±5.3	1.4±2.8	2.3±3.8	0.8±1.2	1.7±3.5	0.035[b,c]

Statistically significant differences established with ANOVA followed by *post-hoc* Scheffé test at $p<0.05$ with [a] differences LM *vs.* LH; [b] differences LM *vs.* HM; [c] differences LM *vs.* HH; [d] differences LH *vs.* HM; [e] differences LH *vs.* HH; [f] differences HM *vs.* HH

TABLE 4
MEDICAL STUDENTS' DAILY FOOD GROUP AND BEVERAGE INTAKE ACCORDING TO GENDER AND FIBRE/FAT INTAKE GROUPS (N=390) ($\bar{X}$±SD)

Parameters	Fibre/fat intake groups				Total	p
	LM	LH	HM	HH		
Grains (g/day)						
Males	353.5±249.4	349.8±199.8	370.0±201.0	325.4±227.0	305.0±189.9	0.040[e]
Females	301.6±369.5	212.0±336.8	360.2±415.8	388.6±329.1	281.4±347.1	<0.001[e]
Milk and dairy products (g/day)						
Males	403.0±229.4	404.2±232.9	397.6±211.2	271.2±71.2	380.6±213.4	0.095
Females	360.0±164.8	475.4±273.9	319.5±198.6	285.5±199.0	372.5±233.4	<0.001[c,d,e]
Eggs (g/day)						
Males	21.7±40.5	64.4±90.6	35.0±57.6	73.7±70.2	46.9±71.0	0.010[c,e]
Females	51.6±87.6	28.5±91.8	43.3±68.6	49.6±55.1	39.0±70.1	0.005[c,d,e]
Meat and meat products (g/day)						
Males	129.9±86.2	127.3±114.6	108.9±68.6	86.4±79.4	118.6±94.1	0.328
Females	120.8±104.3	144.1±82.5	101.5±90.1	73.3±85.4	113.5±93.0	<0.001[c,d,e]
Fish (g/day)						
Males	122.9±124.9	106.0±100.7	144.7±123.0	152.9±94.2	132.8±116.0	0.038[e]
Females	85.4±60.7	71.8±70.9	89.7±81.7	94.2±55.1	83.6±67.8	0.040[e]
Legumes (g/day)						
Males	37.2±38.6	68.2±76.0	58.0±35.5	57.6±41.6	54.3±55.4	0.082
Females	31.4±29.1	15.5±12.3	38.6±29.6	39.2±30.1	29.6±27.1	<0.001[e]
Vegetables (g/day) – without potatoes						
Males	104.8±117.1	133.6±132.7	193.2±135.9	170.6±119.0	150.4±128.0	0.097
Females	141.0±97.3	156.1±155.5	221.1±119.5	171.7±132.2	179.1±130.7	0.001[a]
Potatoes (g/day)						
Males	143.2±80.6	179.3±138.9	155.0±79.7	275.8±122.7	179.4±118.6	<0.001[c,e]
Females	143.9±88.5	100.2±50.6	187.8±174.4	199.6±144.3	152.4±127.5	<0.001[c,e]
Fruits (g/day)						
Males	99.7±218.9	110.9±299.2	196.2±193.4	131.3±233.6	127.2±228.6	0.013[e]
Females	225.2±185.9	258.7±139.4	352.9±215.2	267.2±184.1	279.0±184.9	0.001[d,e]
Sweets (g/day)						
Males	119.4±153.3	195.5±243.8	97.6±38.9	47.5±53.2	130.1±177.1	0.012[d]
Females	125.3±80.7	130.9±89.9	122.6±126.9	69.4±60.6	114.7±97.0	0.001[c,d]
Coffee (mL/day)						
Males	75.4±102.4	63.6±90.1	59.8±100.8	27.1±68.5	60.3±95.5	0.329
Females	85.1±121.1	98.2±97.0	74.9±107.8	36.2±64.7	79.1±101.5	0.003[c,e,f]
Soft drinks (mL/day)						
Males	127.7±151.7	106.5±115.7	47.9±145.6	83.6±132.9	97.1±140.0	0.045[b]
Females	94.7±140.3	66.9±84.8	71.4±85.6	41.0±56.6	64.7±92.5	0.008[a]
Alcoholic beverages (mL/day)						
Males	234.3±281.4	157.2±257.5	102.2±135.8	51.7±47.21	157.7±237.2	0.024[a,e]
Females	72.9±111.3	62.4±87.2	26.4±37.2	19.1±25.3	43.2±73.4	<0.001[a,d,e]

Statistically significant differences established with ANOVA followed by *post-hoc* Scheffé test at $p<0.05$ with [a] differences LM *vs.* LH; [b] differences LM *vs.* HM; [c] differences LM *vs.* HH; [d] differences LH *vs.* HM; [e] differences LH *vs.* HH; [f] differences HM *vs.* HH

of high fibre intake consumed higher amounts of fish, vegetables and fruits, and lower of sweets, coffee, soft drinks and alcoholic beverages by both genders when compared to low fibre groups.

TABLE 5
MEDICAL STUDENTS' DIET-DISEASES KNOWLEDGE SCORE CORRELATION COEFFICIENTS (r) WITH BMI AND DIETETIC PARAMETERS ACCORDING TO GENDER AND FIBRE/FAT INTAKE GROUPS (N=390)

Parameters	Males (N=120)				Females (N=270)			
	Fibre/fat intake groups							
	LM	LH	HM	HH	LM	LH	HM	HH
Body mass index (kg/m^2)	0.46	–0.46*	0.36	0.08	–0.27*	0.10	–0.09	0.02
Energy (MJ)	–0.25	0.32*	–0.28*	–0.27*	–0.14	–0.13	–0.36*	–0.26*
Energy density (kJ/g)	–0.15	–0.06	–0.25*	–0.32*	0.03	–0.13	–0.44*	–0.35*
Proteins (%MJ)	0.26	–0.25	0.05	–0.11	0.46*	–0.07	–0.05	–0.06
Total fat (%MJ)	0.12	0.05	–0.08	–0.37	0.20	0.08	–0.15	0.18
Saturated fatty acids – SFA (%MJ)	0.33*	0.06	–0.25*	–0.81*	0.08	–0.13	–0.19	–0.33*
Monounsaturated fatty acids – MUFA (%MJ)	–0.10	0.29	–0.18	0.06	0.14	0.09	–0.33*	0.33*
Polyunsaturated fatty acids – PUFA (%MJ)	–0.05	–0.38*	–0.34	–0.02	–0.19	0.18	–0.16	0.22
Cholesterol (mg)	–0.15	0.26	0.19	–0.37	0.12	–0.11	–0.37*	–0.28*
Cholesterol (mg/4.184MJ)	0.09	–0.04	0.24	–0.31	0.30*	0.01	–0.17	–0.01
Carbohydrates (%MJ)	0.03	0.16	–0.32	0.33	–0.39*	–0.01	0.11	–0.29*
Dietary fibre (g)	–0.10	0.37*	–0.15	–0.15	–0.15	–0.12	–0.39	–0.12
Dietary fibre density (g/MJ)	0.33*	0.07	–0.36	–0.15	–0.05	–0.05	–0.15	0.11
Alcohol (%MJ)	–0.14	–0.14	0.25	0.12	0.10	–0.03	0.01	0.44*
Grains (g/day)	–0.27	0.03	0.30	–0.12	0.20	–0.08	–0.01	0.06
Milk and dairy products (g/day)	0.13	0.31	0.11	–0.26	–0.11	0.03	–0.10	–0.07
Eggs (g/day)	–0.05	0.08	0.25	–0.25	0.26	–0.09	0.08	0.13
Meat and meat products (g/day)	–0.06	0.22	–0.35	0.09	0.03	–0.12	–0.19	–0.10
Fish (g/day)	–0.24	0.04	0.33*	0.29*	0.25	–0.04	0.37*	0.24*
Legumes (g/day)	0.02	–0.22	–0.31*	–0.32*	0.26	0.17	–0.35*	–0.21
Vegetables (g/day) – without potatoes	0.40*	0.23	0.22*	0.35*	–0.13	–0.08	0.34*	0.27*
Potatoes (g/day)	–0.30	–0.21	–0.01	–0.47*	–0.03	0.12	0.16	0.10
Fruits (g/day)	0.03	0.30*	–0.19	–0.33	–0.41*	–0.06	0.26*	0.36*
Sweets (g/day)	–0.27	0.11	0.37	0.42	–0.09	0.11	0.18	–0.20
Coffee (mL/day)	0.43*	0.02	–0.30	0.40	–0.02	–0.08	–0.07	0.18
Soft drinks (mL/day)	–0.19	0.00	–0.47*	–0.76*	0.01	0.08	–0.26*	–0.41*
Alcoholic beverages (mL/day)	–0.19	0.25	0.15	–0.31	0.06	–0.08	–0.11	0.09

* correlation coefficients statistically significant at $p<0.05$

Diet-disease knowledge score correlations with dietary intakes of medical students

Correlation analyses were used to test association between BMI and dietetic parameters with overall diet-diseases knowledge score in students among each fibre/fat intake groups and results are presented in Table 5. For both genders in high fibre groups (HM and HH) statistically significant ($p<0.05$) negative correlations were found between overall examined nutrition knowledge and daily energy intake ($p=0.019$, $p=0.001$), energy density of the diet ($p=0.038$, $p=0.001$), saturated fatty acids intake ($p=0.036$, $p<0.001$), consumption of legumes ($p=0.027$, $p=0.001$) and soft drinks ($p=0.001$, $p<0.001$). Positive correlations, which implies higher intake with increased diet-disease knowledge among high fibre groups, were established for fish ($p=0.027$, $p=0.001$) and vegetables consumption ($p=0.019$, $p=0.001$) in both genders. Additionally, just in females, weak but significant correlation was established between knowledge and fruit intake ($p=0.038$, $p=0.007$).

Discussion

The results of this research make a valuable contribution to the understanding of importance of medicine students' education in the field of nutrition. It was confirmed that knowledge could be translated into healthy diet and in this light it is valuable to make students understand their own dietary intakes, to improve them and together with the knowledge they have, to take the opportunity to act as a model in counselling their patients. Primary care physicians are the first that patients ask

about their health problems and seek for diet-disease counselling, so defining and improving medical students' healthy lifestyle is a promising strategy for improving future physician diet-disease knowledge and positive attitudes toward patients' counselling[6].

The conducted research found that among studied medical students, the knowledge about diet-disease relationship was not satisfactory, where barely one third of students had top knowledge, males slightly better than females. This situation is an international issue and European educators have published similar concerns about the inadequacy of medical nutrition education[28]. Knowledge about dietary factors that can reduce the risk of common diseases (cancer and cardiovascular diseases) was better than their knowledge about sources of certain desirable food components (namely fat and fibre). The displayed lack of knowledge about sources of fat and dietary fibre, is similar to the other studies conducted on general population[29,30]. This is of special concern, because if students are unsure about the foods that represent sources of dietary fibre and fat in their diet, they are unlikely to understand the dietary recommendations and it may be a key for adequate patient counselling. Since patients expect from physician exact recommendations which foods should they include or exclude from daily diet, lack of knowledge in this segment could question the physician's counselling credibility, and show the need to guide education in this direction. Diet-disease knowledge on cardiovascular diseases was a field that students seized more than on cancer and dietary factors. Students with higher intake of fibre were more knowledgeable what correlated to their dietary habits. Despite revolutionary 20-th century advances in medical sciences and accumulating scientific evidence on the significance of dietary modification to disease prevention, there is a vast dichotomy between the perception of the public and the understanding of medical practitioners on the role of proper nutrition in maintaining health and preventing diseases. Potential results of medical ignorance and neglect of dietary counselling contribute to the growing epidemic of increased risk of cardiovascular diseases, hypertension, diabetes, some cancers and obesity as a non-communicable diseases encompassed the most common causes of mortality in the developed world[31]. Despite the intuitive appeal of education as a means of improving diet, many studies have failed to find significant association between nutrition knowledge and dietary behaviour[32], what can explain insignificant relationship between knowledge and dietary intake obtained in two of the four examined groups. On the other hand, according to Wardle and co-workers[33], people with higher knowledge about fat, fruit and vegetables are more likely to meet the consumption recommendations of these components, what is confirmed among nutrition-conscious groups of high fibre intake. It was shown that knowledge is best translated into consumption when it links food attribute-related knowledge with consequence-related knowledge[34]. The observed values of correlations between nutrition knowledge and dietary intakes were in accordance to other researchers[33,35]. Study on effect of nutrition knowledge on dietary intakes among Croatian students found that food choice that are more in accordance with recommendations are made by students with higher overall nutrition knowledge[36], which is similar to our results. The observation that two thirds of youth lack adequate knowledge could be partially explained with the fact that generally nutrition knowledge is better in middle-aged than in young groups[37]. It also emphasizes the need for adequate nutrition training in diet-disease field for medical students.

Physicians with high levels of confidence in their nutrition counselling ability are more likely to assist their patients in making dietary changes than those with low confidence[6]. Therefore, it is necessary to increase students' understanding of their diet habits likewise health behaviours. Regarding nutritional status, medical students' BMI was quite similar to that of Spanish[38], Swedish[39], and Italian[40] students but unlike others, it was found that in a range of moderate fat intake, higher fibre intake was significantly associated with lower obesity rates only in females. Since to the best of our knowledge, there are no studies that examined the dietary intake of the student population with regard to different fibre/fat categories, it is worth making a short comparison with literature data from the recent studies that examined the nutrient intakes of university students in different countries. The dietary intakes of studied students were comparable with the data from Spain[38], Sweden[39], Canada[41] and Greece[42] obtained with a 24-h dietary recall. When study results were compared with Croatian data[43], it was evident that studied student group had about 30% lower total energy intakes, while the proportion of macronutrients were similar. This provided a platform for setting the cut-off points in fibre/fat group's creation, based on the national representative sample. Similar results obtained with different dietary assessment methods gave an opportunity to introduce new approach using some food components as predictive factors of future dietary habits and pointed out the need of clustering the dietary intakes with the aim to predict a future dietary behaviour.

A recently recognized factor potentially influencing nutrient intake is the energy density of the diet, as a composite factor of dietary fibre, fat and water and, as such, figures as a tool in energy regulation[44]. In the presented research, the energy density was strongly affected by fibre/fat groups. By this study, dietary fibre could be used as predictor of energy intake since the diet patterns of groups with higher fibre intake were characterized by decreased food consumption due to the physiological explanation for the role of fibre as a basis in energy regulation which includes reducing energy density, decreasing nutrient absorption rate, thereby slowing the return of hunger, up-regulating satiety hormones and sequestering energy-providing nutrients causing them to be excreted[45]. Interestingly, the intake of dietary fibre among studied medical students on total meet the recommendations, while there is an observed downsize trend in many Western countries, where it is believed that its intake is

still decreasing[46]. In the study, women tend to have more fibre dense diets than men what is in accordance with another study confirming that college women consume more fibre than men[47]. However, data were opposite to the dietary pattern of Croatian adults, characterised with higher fibre consumption among males[48].

Although it has been shown that the incorporation of lower-fat foods (particularly dairy products) into the diet consistently reduces fat and saturated fat intakes while generally maintaining adequate micronutrient intakes in adults[49], study results showed that those who consume more proteins also consume more dairy fats. Those unexpected results, also recently confirmed among adolescents[50] disagree with the results of a study of Georgiou and co-workers[51], which reports that college students prefer skim milk more than other dairy products. In our study, the intake of total fat, SFA and MUFA was inversely associated with fibre intake since the higher consumption of poultry and lean meat and also fish, that observed among participants with higher fibre intake, contributed to a relatively good profile of fatty acids and an adequacy of total fat intakes.

The primary strength of this study was identified level of diet-disease knowledge in a relation to healthy dietary intakes among medical students. Additionally, the results stressed the need to educate students by nutrition approach in which they could apply their knowledge in a combination to healthy dietary intakes in order to deliver condense information to patients. However, there are some limitations. The usual limitations of using self-reported data apply to this study. The second limitation is that the study population were medical students from University of town Rijeka, so the results may not be generalised to other medical students in Croatia. Consequently, the findings of this study will require confirmation in a statistically significant sample of Croatian medical students.

Conclusion

Among the studied medical students diet-disease knowledge was generally inadequate, where higher level of diet-disease knowledge was among those with higher dietary fibre intake. The diet of those groups seems to be a factor that ensures lower obesity rates, lower intake of energy, lower consumption of coffee, sweets and alcoholic drinks, and greater fruit, vegetable and fish consumption in comparison to groups of lower fibre intake. They also had relatively good fatty acid profile and adequacy of total fat intake. On the basis of the obtained results, it is clear that medical schools should include in their nutrition programs the opportunity for students to learn about their own dietary and lifestyle behaviours, in order to more knowledgably and convincingly counsel their future patients.

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PREHRAMBENO ZNANJE O KARCINOMU I SRČANO-ŽILNIM BOLESTIMA I PREHRAMBENI UNOS STUDENATA MEDICINE

S A Ž E T A K

Ciljevi ovog istraživanja bili su utvrditi znanje studenata medicine o povezanosti prehrambenih čimbenika i rizika obolijevanja od karcinoma i srčano-žilnih bolesti i ispitati da li to znanje ima utjecaja na njihov prehrambeni unos. Tri stotine i devedeset studenata medicine (muškaraca i žena) uključeno je u istraživanje i grupirano s obzirom na njihov dnevni unos prehrambenih vlakana i masti. Za pitanja o prehrani i bolestima koristio se Upitnik o općem znanju o prehrani za odrasle, a procjena prehrane izvršena je pomoću Upitnika o učestalosti unosa hrane. Dobiveni rezultati pokazali su da je studentsko znanje o povezanosti prehrani i bolesti uglavnom nedovoljno. Bolje znanje o prehrani i bolestima imali su ispitanici s većim unosom prehrambenih vlakana, sa boljim rezultatima poznavanja prehrambenih čimbenika koji se povezuju sa rizikom za srčano-žilne bolesti nego onih koji se povezuju sa rizikom obolijevanja od karcinoma. Bolje znanje o prehrani i bolestima pozitivno je koreliralo sa većim unosom ribe ($p=0,027$, $p=0,001$) i povrća ($p=0,019$, $p=0,001$) kod grupa sa većim unosom vlakana za oba spola, a u žena dodatno i sa većim unosom voća ($p=0,038$, $p=0,007$). Pored toga, viši unos prehrambenih vlakana među ispitanicima je čimbenik koji osigurava manju pojavu pretilosti, niži energetski unos i manje konzumiranje kave, slastica i alkoholnih pića. Temeljem rezultata ovog istraživanja, jasno je da bi medicinski fakulteti trebali uvrstiti u svoj program o prehrani i mogućnost da studenti upoznaju svoje ponašanje u prehrani i načinu života a sa ciljem postizanja na znanju utemeljenog i uvjerljivog savjetovanja budućih pacijenata.

Abbreviations

LM: low fibre-moderate fat
LH: low fibre-high fat
HM: high fibre-moderate fat
HH: high fibre-high fat
BMI: body mass index
MJ: Mega Joules
AMDR: Acceptable Daily Macronutrient Range
FFQ: Food Frequency Questionnaire
DRI: Dietary Reference Intakes
RDA: Recommended Dietary Allowances
WHO: World Health Organization
SFA: saturated fatty acids
MUFA: monounsaturated fatty acids
PUFA: polyunsaturated fatty acids