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# Nutrition Knowledge and Diet in Female College Students in Turkey: Youth Education in Nutrition Initiative/Nutrition Education Works (YENI/NEW)—A Cross-Sectional Pilot Study

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**Abstract:** Healthy dietary patterns can play a major role in preventing chronic diseases. Improving nutrition-related knowledge in young individuals is considered a promising approach to adopting healthy dietary behaviors, thus improving outcomes later in life. However, healthy eating habits in college students may prove challenging to acquire and maintain. This cross-sectional pilot study aimed to investigate the relationship between nutrition knowledge and its effect on dietary factors, body weight, and body composition in female college students in Turkey. Second- and third-year female college nutrition students (NS), ($n$ = 85) and corresponding non-nutrition/non-health sciences students (NNS) ($n$ = 80), aged 20–22 years old, were evaluated using a validated nutrition knowledge questionnaire, 24 h recalls, anthropometry, and body composition analysis using bioelectrical impedance during the 2015–2016 academic year. The findings revealed that nutrition knowledge was positively associated with increased intake of water, fruits and vegetables, grains, and fiber, whereas total carbohydrate intake exhibited an inverse relationship with nutrition knowledge. Moreover, protein and lipid intake, while not significant, appeared to show higher and lower values, respectively, for the NS participants compared to NNS, revealing a healthier trend for more nutrition-knowledgeable students, which was similar to the finding of a marginally better body composition profile in nutrition-knowledgeable students. As young adulthood is critical for the development of dietary habits, demonstrating the effectiveness of nutrition education is important as a potential tool for public health in terms of improving the risk of chronic diseases.

**Keywords:** nutrition knowledge; college students; diet; chronic disease risk; females; Turkey



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## 1. Introduction

Non-communicable diseases (NCDs), such as cardiovascular disease, type 2 diabetes, and cancer, constitute approximately 60% of deaths globally according to the WHO [1]. These diseases are strongly associated with diet and other lifestyle factors; hence, prevention, leading to the lower incidence of NCDs, could be achieved to a considerable extent if dietary patterns are improved [2]. Nutrition knowledge is regarded as being an essential part of health literacy, with low health literacy associated with poor health outcomes, thus necessitating research that can inform community nutrition education and public health policy [3]. More specifically, recent research in Italy has corroborated the positive correlation between higher nutrition knowledge and better quality in terms of dietary intake [4]. Nutrition knowledge, as assessed in a working environment using the General Nutrition Knowledge Questionnaire (GNKQ) in relation to 828 employees, was positively associated with diet quality and lower blood pressure, although the interrelationships between these

variables are complex [5]. Furthermore, significant differences in nutrition knowledge have been reported between dietitians and non-dietitians in Japan [6].

Moreover, a study in the US at California State University San Diego documented that majoring in nutrition in college produced a healthier BMI for female students in relation to factors including better adherence to dietary guidelines, more regular meal patterns, and healthier snack choices [7].

In addition, energy intake (density) has been associated with body composition in Chinese adults [8]. Dietary factors were shown to affect body composition in young Spanish adults (median age 20.38 years), and protein intake was particularly associated with fat-free mass and BMI [9]. On the other hand, no relation between energy intake and adiposity was found in young adults [10], while, in another study, neither energy intake nor diet composition were correlated with body composition [11].

There has been evidence to suggest that nutrition knowledge can empower individuals in relation to health promotion and chronic disease risk reduction by influencing dietary intake. However, while some work has indicated that improving nutrition knowledge is necessary, such an improvement would produce a stronger result if synergized with other lifestyle changes [12]. Regardless, there is interest in delineating to what extent nutrition knowledge can correlate with different and/or improved dietary practices, especially among younger populations during their formative years, when following healthful dietary patterns can create significant potential for improvements in health and the prevention of disease. Younger adults and college students are particularly idiosyncratic, since college is a period in life during which students leave home for the first time and need to make dietary choices independently, with often limited knowledge, experience, time, and financial resources, leading to suboptimal dietary patterns and potential negative health outcomes [13]. In an extensive systematic review of the evidence considering 20 research studies, all with college students, Deliens et al. concluded that nutrition education, among other contributing factors, may improve dietary intake in university or college students [14]. Additionally, there is evidence to support that adhering to healthy dietary patterns, such as the Mediterranean diet, may improve academic performance along with quality of life, as well as physical and mental health [15].

According to the most recent WHO data reported for Turkey, in 2016, in the age range of 10–19 years, the prevalence of a BMI over two standard deviations from the mean in males was 10.2% versus 9.4% for females [16]. Interestingly, however, this pattern is reversed in adulthood, whereby the mean BMI for males is 27.1 versus 28.6 for females [16]. On the other hand, micronutrient deficiencies such as iron deficiency in school-age girls and boys [17,18] have been reported in Turkey, adding to the public health challenges. Thus, current health and diet statistics underline the importance of focusing on young adult women from a public health perspective, and college females constitute a good group for such studies. While a well-studied population, college students are particularly interesting in terms of studies, since college is a space for continuous behavior formation, along with the fact that increasing access to higher education has been employed as a tool for social mobility and growth in the middle class, revitalizing the economy in the long run. Furthermore, according to the WHO World Mental Health Surveys, there is an increased risk of mental disorders, stress, and anxiety among university students [19]. For these reasons, it is still pertinent to investigate the college population, both in general and specifically for Turkey. In Turkey, there is a limited body of literature regarding nutrition and diet studies in the college population. Moreover, the social and political scene in Turkey is diverse, with a combination of secular and religious practices that form an interesting and not linearly deterministic decision-making system on the consumer's part. Therefore, the delivery of scientific knowledge cannot necessarily predict a change in attitudes and behavioral outcomes. For these reasons, the college population, especially that of women, is of significant interest, with possible predictive potential for dietary behavior in future generations.

Along these lines, the present work with female college students in Turkey, an understudied population, aimed to examine the nutrition knowledge, dietary intake, and eating habits of nutrition and non-nutrition students. In addition, body composition was measured to assess the relationship between diet and body composition in either group, as well as potential differences between the two groups.

Turkey is a large country undergoing an epidemiological transition with significant public health concerns related to chronic diseases [20], specifically diabetes. A multi-ethnic and multi-cultural country, hosting approximately 50 different Muslim and/or non-Muslim ethnic groups, such as Sunni Turks, Alevi Turks, Sunni Kurds, Alevi Kurds, Circassians, Lazis, Armenians, Georgians, Jews, Greeks, Arabs, Assyrians, and others, Turkey is also significantly diverse, particularly from a socioeconomic and cultural perspective when considering college students [21]. Studying whether nutrition knowledge may influence diet quality may prove an interesting avenue, allowing us to approach diet in a manner that will improve the risk of chronic disease, especially in the young population. Recent research on female college students in Turkey reported that there is a high prevalence of smoking and alcohol consumption among students [22], while the residency mode (home versus dormitories) appears to also play a role, with better eating habits being associated with home residency [22]. Moreover, the same study showed that income produces a more robust representation of a healthier BMI among college female students in Turkey, indicative of better health outcomes, potentially associated with the higher economic status of the family. Another recent study observed that college students from Turkey had the lowest BMI compared to students from Greece, Poland, and Hungary, but engaged less often in obesity-preventive behaviors, while showing the highest preference for behaviors related to physical health, including rational nutrition and physical activity [23].

Young individuals typically do not demonstrate high obesity levels, as per BMI and % fat mass, especially compared to other (older) population groups. Furthermore, a young age is typically naturally protective against chronic diseases, since negative health outcomes associated with chronic pathological conditions require time to manifest. However, it is important to underline that poor and/or suboptimal practices contribute significantly over time to the manifestation of chronic disease, thus transforming a habitual issue into a public health concern. In this context, from a preventive standpoint, it is important to pay attention to earlier life stages, including young adult populations, even if, at this age/stage, apparent deviations are not as common yet. Such an approach, along with other policies supporting public health, could provide a powerful strategy to reduce chronic disease and alleviate pressure on healthcare systems and budgets.

Hence, the objective of this study was to provide a proof of concept through a feasibility approach regarding the potential for nutrition education and health improvements in female college students in the idiosyncratic Turkish setting. The study focused on an understudied population in an understudied setting. The research hypothesis was that female nutrition college students would demonstrate higher nutrition knowledge and apply this information by engaging in superior dietary habits compared to their non-nutrition counterparts.

## 2. Materials and Methods

### *2.1. Population and Setting*

The study participants were second- and third-year female nutrition students (NS) ($n$ = 85) and non-nutrition/non-health sciences ($n$ = 80) students (NNS) enrolled at Istanbul Yeni Yuzyil University during the academic year 2015–2016. Inclusion criteria were as follows: female full-time student, aged between 20 and 22 years, no pregnancy, no health conditions or medication, no smoking, and no supplement intake. Students had to be either nutrition majors or non-nutrition majors. Exclusion criteria for the non-nutrition majors were as follows: students enrolled in majors in the college of health science or schools of medicine, dentistry, or pharmacology. Moreover, for non-nutrition majors, even if not within any of the excluded schools and colleges, the participant must not

have taken nutrition courses at the university level or a home economics class during high school, to ensure sufficient differences in nutrition knowledge between NS and NNS participants. All students were enrolled full-time, not employed, and not in any assistantship program. The study took place in Istanbul, Turkey, at the recruiting center of Istanbul Yeni Yuzyil University.

### *2.2. Ethics*

The Ethics Committee (Institutional Review Board; IRB) of Istanbul Yeni Yuzyil University reviewed and approved the present study (No. SBF-13070500X_YENI). All study participants provided their written informed consent prior to enrollment in the study.

### *2.3. Questionnaire*

The participants were administered a general nutrition knowledge questionnaire to directly assess nutrition knowledge [24]. This self-administered questionnaire was a modified version of the general nutrition knowledge questionnaire originally developed by Parmenter and Wardle [25], previously translated into Turkish and validated in a student population in Turkey [24]. The questionnaire consisted of 133 questions testing the following areas of nutrition knowledge: section A—dietary recommendations regarding healthy eating (11 questions), section B—food sources and nutrient content of various foods (73 questions), section C—everyday/common food selection (10 questions), section D—diet and disease relationship (39 questions). Additionally, 26 questions covering the demographic information of the participants were included in a separate section (section E) of the questionnaire. Each participant completed the questionnaire via "paper and pencil" under supervision, in groups, as per their convenience, with individual participants using the time necessary to complete the questionnaire at their own pace, in one sitting. A training and normalization session took place with all participants prior to being given the questionnaire.

### *2.4. Data Analysis—Statistics*

The responses were converted into values of 1 and 0 for correct and incorrect answers, respectively. Section sub-scores and overall nutrition knowledge scores were calculated. Mean scores and standard errors of means were calculated for each item and the whole questionnaire. Statistical analyses were performed using IBM SPSS version 24. Normality was assessed via the graphical method (histogram) and data were found to follow a normal distribution. Two-tailed *t*-tests were used to make the comparisons presented in the Results section [26]. Significance was accepted at $p < 0.05$.

### *2.5. Food Intake and Diet Analysis*

The food intake of the participants was assessed using a standard 24 h recall obtained by three trained dietitians with the multi-pass method [27]. Normalization sessions were held to minimize intra-operator error. Results were analyzed by diet analysis software especially developed to include local foods consumed in Turkey: Beslenme Bilgi Sistemi (BeBiS) [28]. The participants were interviewed as per their convenience on any weekday except Monday (to avoid non-typical Sunday dietary consumption) and the foods and beverages consumed during the previous weekday were recorded. Electronic pictures of foods commonly consumed in Turkey, provided by BeBiS, were used to estimate portion sizes. Food intake was analyzed with BeBiS for energy and nutrient content and macro- and micronutrients, as explained before [28].

Diet recalls were further analyzed manually to evaluate the consumption of the following food groups: fruits, vegetables (not including potatoes), grains, meat/fish, dairy, eggs, legumes, fats/oils, alcohol, and finally a group of additional kcals, including food items such as desserts that did not fall within any other food group. The number of servings for the above food groups was determined according to the USDA MyPlate standard serving sizes.

### *2.6. Physical Assessment*

Anthropometric measurements of body weight and height, as well as the assessment of body composition, were obtained by trained researchers according to standardized protocols. Height (m) was measured to the nearest 0.1 cm using a stadiometer with participants standing upright in bare feet while keeping their heels together, attached to the backwall and looking straight ahead. Weight (kg) was measured to the nearest 0.1 kg with a calibrated electronic scale with participants in bare feet, in light clothing, and with an empty bladder, following a 4 h fast from food. Height and weight were measured in triplicate, and an average value was used for analysis.

Body composition was assessed with a bioelectrical impedance body composition analyzer (TANITA BC-418 MA, Tokyo, Japan). Participants stood in bare feet, in light clothing, and with an empty bladder, following a 4 h fast from food. Body mass index (BMI) was calculated by dividing the weight in kg by the height in m squared ($m^2$), and it was used to classify the participants as normal weight, overweight, or obese, according to the cut-off points adopted by the International Obesity Task Force [29]. Basal metabolic rate (BMR) was estimated based on predictive equations and bioelectrical impedance equipment [30].

## 3. Results

The current work aimed to assess the relationship between nutrition knowledge and the quality of the diet, as well as basic anthropometry and body composition, comparing a group of nutrition college students (NS) to non-nutrition students (NNS). There were no significant differences in the anthropometric parameters between the NS and NNS groups as per height, weight, and subsequently BMI (Table 1), thus rendering the two groups similar and comparable in terms of basic anthropometry. There was a difference in the age by approximately one year in favor of the NS group. While one year is practically no different from a statistical standpoint, it was found be significant due to the high homogeneity within each of the two groups of participants. Given the fact that the nutrition major in Istanbul Yeni Yuzyil University is an English-speaking program, all students in the major attend one year of college preparatory English language classes, in addition to their language qualifiers, to learn terminology and field-specific English. As a result, students in the nutrition major are typically older by a year compared to their counterparts in other programs, resulting in the reasonable difference observed in our results.

**Table 1.** Anthropometric characteristics of participants.

| | **NS (*n* = 85)** | **NNS (*n* = 80)** |
|---|---|---|
| Age (years) | 20.9 ± 0.1 | 20.3 ± 0.1 * |
| Height (cm) | 164.1 ± 0.6 | 162.4 ± 0.7 |
| Weight (kg) | 56.6 ± 0.9 | 57.2 ± 1.3 |
| BMI | 21.0 ± 0.3 | 21.6 ± 0.4 |

NS: nutrition students; NNS: non-nutrition students; BMI: body mass index. Values are means ± SEM; asterisk (*) denotes statistical significance at $p < 0.05$.

In terms of nutrition knowledge, NS students were significantly more knowledgeable, overall and in all subsections of the questionnaire, compared to NNS students. More specifically, the NS group scored significantly and consistently higher than NNS in terms of dietary recommendations regarding healthy eating (section A), food sources and the nutrient content of various foods (section B), everyday/common food selection (section C), and the diet and disease relationship (section D), as well as in the total score (Table 2).

Despite the significant difference regarding nutrition knowledge, there were no statistically significant differences between the NS and NNS in terms of elements of body composition and BMR assessed. More specifically, BMR was similar, albeit marginally higher for NS. While both percent body fat and fat mass were similar between the NS and NNS groups, there was a trend for lower values in the case of NS, with an inverse trend

seen for fat-free mass and total body water (Table 3), all of which, taken together, point towards a more favorable health profile for the NS group.

**Table 2.** Nutrition knowledge assessment of nutrition students versus non-nutrition students.

| Section (Max Points) | NS ($n$ = 85) | NNS ($n$ = 80) | $p$-Value |
|---|---|---|---|
| A (max 11) | 8.5 ± 0.2 | 6.3 ± 0.2 * | 0.001 |
| B (max 73) | 53.5 ± 0.8 | 39.9 ± 0.9 * | 0.001 |
| C (max 10) | 6.3 ± 0.2 | 5.0 ± 0.2 * | 0.001 |
| D (max 39) | 29.1 ± 0.4 | 21.8 ± 0.6 * | 0.001 |
| Total (max 133) | 97.4 ± 1.2 | 72.8 ± 1.4 * | 0.001 |

NS: nutrition students; NNS: non-nutrition students; values are means ± SEM; A through D refer to specified sections of the questionnaire used. Section A: dietary recommendations regarding healthy eating, section B: food sources and nutrient content of various foods, section C: everyday/common food selection, section D: diet and disease relationship. Asterisk (*) denotes statistical significance at $p < 0.05$.

**Table 3.** Basal metabolic rate and body composition analysis for nutrition students and non-nutrition students.

| | NS ($n$ = 85) | NNS ($n$ = 80) |
|---|---|---|
| Basal Metabolic Rate (kcal) | 1318.2 ± 10.9 | 1311.0 ± 15.8 |
| Body Fat (%) | 24.9 ± 0.6 | 26.1 ± 0.8 |
| Fat Mass (kg) | 14.5 ± 0.6 | 15.7 ± 0.9 |
| Fat-Free Mass (kg) | 42.2 ± 0.4 | 41.5 ± 0.5 |
| Total Body Water (kg) | 30.9 ± 0.3 | 30.4 ± 0.4 |

NS: nutrition students; NNS: non-nutrition students; values are means ± SEM.

When assessing the intake of energy, water, and macronutrients, no significant difference was found between the NS and NNS groups for energy, although NS showed somewhat lower values than NNS (Table 4). Interestingly, while there were no significant differences between the two groups for macronutrients, except for carbohydrates, which were lower for the NS group, there was a trend towards higher protein and lower fat consumption for NS compared to NNS. Moreover, there was significantly higher consumption of water and fiber for NS compared to NNS (Table 4).

**Table 4.** Energy, water, macronutrient and fiber intake for nutrition and non-nutrition students.

| | NS ($n$ = 85) | NNS ($n$ = 80) |
|---|---|---|
| Energy (kcal) | 1503.9 ± 47.2 | 1650.8 ± 59.8 |
| Water (mL) | 2330.8 ± 90.7 | 1894.2 ± 90.1 * ($p$ = 0.001) |
| Protein (g) | 65.9 ± 2.7 | 60.7 ± 2.8 |
| Fat (g) | 67.7 ± 2.6 | 73.6 ± 3.0 |
| Carbohydrate (g) | 155.6 ± 6.2 | 180.6 ± 7.5 * ($p$ = 0.027) |
| Fiber (g) | 19.8 ± 0.9 | 17.5 ± 0.9 * ($p$ = 0.037) |

NS: nutrition students; NNS: non-nutrition students; values are means ± SEM; asterisk (*) denotes statistical significance at $p < 0.05$.

Interestingly, when the results for intake were corrected for body weight, we observed only the carbohydrate intake to be significantly lower for NS compared to NNS, with the rest of the trends remaining the same as those prior to the correction employed (Table 5).

Correction steps were performed for energy intake, water intake, macronutrient intake, and fiber intake, as a normalization step, whereby the reported intakes were divided by the BMI, to correct for any potential differences that may be attributed to differences in BMI (in the event that BMI could function as a confounding factor towards the results and bias the conclusions). When we corrected the original results for BMI, similar results to those generated by the body weight correction were obtained (Table 6).

**Table 5.** Corrected by body weight intake of energy, water, macronutrient and fiber for nutrition and non-nutrition students.

| | NS ($n$ = 85) | NNS ($n$ = 80) |
|---|---|---|
| Energy (kcal)/BW (kg) | 26.9 ± 0.9 | 30 ± 1.3 |
| Protein (g)/BW | 1.2 ± 0.1 | 1.1 ± 0.1 |
| Fat (g)/BW | 1.2 ± 0.1 | 1.3 ± 0.1 |
| Carbohydrate (g)/BW | 2.8 ± 0.1 | 3.3 ± 0.2 * ($p$ = 0.014) |

NS: nutrition students; NNS: non-nutrition students; BW: body weight; values are means ± SEM; asterisk (*) denotes statistical significance at $p < 0.05$.

**Table 6.** Results corrected by BMI for intake of energy, water, macronutrient and fiber for nutrition and non-nutrition students.

| | NS ($n$ = 85) | NNS ($n$ = 80) |
|---|---|---|
| Energy (kcal)/BMI | 72.4 ± 2.4 | 78.6 ± 3.4 |
| Protein (g)/BMI | 3.2 ± 0.1 | 2.9 ± 0.1 |
| Fat (g)/BMI | 3.3 ± 0.1 | 3.5 ± 0.2 |
| Carbohydrate (g)/BMI | 7.5 ± 0.3 | 8.6 ± 0.4 * ($p$ = 0.034) |

NS: nutrition students; NNS: non-nutrition students; BMI: body mass index; values are means ± SEM; asterisk (*) denotes statistical significance at $p < 0.05$.

An analysis of the food intake data was performed to obtain the contributions of the food groups in the diet as a measure of diet quality. The analysis showed that nutrition students consumed significantly more servings of fruits, vegetables, and eggs, while consuming significantly fewer servings of grains (Table 7).

**Table 7.** Consumption of food groups for nutrition and non-nutrition students.

| Food Groups (Number of Servings) | NS ($n$ = 85) | NNS ($n$ = 80) | $p$-Values |
|---|---|---|---|
| Fruits | 1.96 ± 0.19 * | 1.29 ± 0.33 * | 0.01 |
| Vegetables | 2.91 ± 0.08 * | 2.28 ± 0.11 * | 0.02 |
| Grains | 4.93 ± 0.54 * | 6.15 ± 0.52 * | 0.01 |
| Meats/Fish | 2.25 ± 0.16 | 2.24 ± 0.11 | 0.97 |
| Dairy | 2.34 ± 0.16 | 2.18 ± 0.11 | 0.47 |
| Fats/Oils | 2.91 ± 0.54 | 3.41 ± 0.05 | 0.15 |
| Legumes | 1.62 ± 0.01 | 0.15 ± 0.05 | 0.01 |
| Eggs | 0.66 ± 0.01 * | 0.39 ± 0.01 * | 0.01 |
| Additional calories (kcal) | 2.50 ± 0.22 | 3.13 ± 0.38 | 0.08 |

NS: nutrition students; NNS: non-nutrition students; values are means ± SEM; asterisk (*) denotes statistical significance at $p < 0.05$.

Finally, nutrition students exhibited higher consumption of pantothenic acid and biotin, as well as potassium, calcium, and iodine, albeit not always meeting the recommendations (Table 8). The consumption of all other vitamins and minerals was similar between the two groups.

**Table 8.** Micronutrients with significant differences between the nutrition and non-nutrition students.

| Micronutrient | NS | NNS | Dietary Recommended Intake | $p$-Values |
|---|---|---|---|---|
| Pantothenic Acid (mg/d) | 4.59 ± 0.42 | 3.62 ± 0.17 | 5 mg/d | 0.033 |
| Biotin (µg/d) | 34.48 ± 1.55 | 29.04 ± 1.82 | 30 µg/d | 0.024 |
| Potassium (mg/d) | 2338.79 ± 90.04 | 2052.37 ± 90.47 | 4700 mg/d | 0.026 |
| Calcium (mg/d) | 767.75 ± 30.32 | 669.26 ± 31.74 | 1000 mg/d | 0.028 |
| Iodine (µg/d) | 176.24 ± 9.22 | 139.03 ± 7.75 | 150 µg/d | 0.002 |

NS: nutrition students; NNS: non-nutrition students; values are means ± SEM; statistically significant at $p < 0.05$. Consumption of all other vitamins and minerals was similar between the two groups.

In summary, the obtained results, taken together, indicate that nutrition knowledge is positively associated with healthier dietary patterns in female college students, as reflected by their consumption of significantly more servings of fruits, vegetables, and grains; higher fiber intake with lower carbohydrate intake; marginally lower intake of fats; and higher protein intake, as well as their higher consumption of water and certain micronutrients, compared to students with lower levels of nutrition knowledge.

## 4. Discussion

The work presented herein aimed to investigate the relationship between nutrition knowledge, basic anthropometric measurements, and body composition, by assessing the quality of the diet in female college students in Istanbul, Turkey. In the studied student population, NS students obtained higher scores for total nutrition knowledge, as well as on all the sections of the nutrition knowledge questionnaire, i.e., dietary recommendations regarding healthy eating, food sources and nutrient content of various foods, and everyday/common food selection, as well as diet and disease relationship. No significant differences in body composition between the two groups were observed, although both the body fat percentage and fat mass were higher for non-nutrition students compared to nutrition students. This appears to be in agreement with the higher overall energy intake in the former group, although not significant due to the small sample size. However, when interpreting the results and considering the predictive power over time in the habitual realm, it is important to understand that small energy intake differences (approx. 100 kcal), if typified and persistent over time, can accumulate, especially at older age, when the BMR declines and sedentary lifestyles become more pervasive, leading to significant weight gain and body fat accretion, thus producing an unfavorable body composition and elevated chronic disease risk. The overweight and obesity prevalence have increased in the adult Turkish population in recent years [31,32], with abdominal obesity and metabolic syndrome being more prevalent in women [33]. Interestingly, low education levels in Turkish women are reported as a contributing factor for the development of overweight/obesity and associated risks [33]. These observations highlight more emphatically the importance of nutrition education, especially among women. Such an approach may be more effective when employed in earlier life stages, when desirable eating habits can still be more easily established, maintained, and given time to produce favorable outcomes. While this study population comprised students in higher education, the differences in nutrition knowledge between nutrition and non-nutrition students were significant, indicating the importance of nutrition education specifically in efforts towards healthier dietary intake.

In an interesting study recently conducted in Austria, researchers demonstrated that more hours of nutrition education result in higher levels of nutrition knowledge and greater nutrition literacy in adolescents, which may lead to health-promoting dietary habits [34]. The authors did not specifically assess the correlation between the achieved improvement in nutrition literacy and health outcomes, diet quality, or body composition. However, a separate study in Italy in adolescents showed that nutrition knowledge was positively associated with the intake of pasta/rice, fish, vegetables, and fruit, and negatively associated with the consumption of sweets, snacks, fried foods, and sugary drinks, thus indicating a healthier dietary pattern for the more nutrition-literate participants [35]. In the study described here, investigating young participants at a more advanced age and more independent life stage (college students), we revealed similar trends as per the food pattern consumed, with nutrition students consuming more servings of fruits, vegetables, and eggs and fewer servings of grains compared to the less nutrition-knowledgeable student group. Interestingly, while NS consumed significantly fewer grain servings and lower amounts of carbohydrates compared to NNS, NS consumed significantly more fiber. This observation suggests that NS students likely consumed healthier carbohydrates and a greater variety of carbohydrate-rich sources, as indicated by their higher consumption of fruits and vegetables as well as grains. The significant differences in carbohydrate intake persisted when the values were corrected/normalized for body weight and BMI.

The effectiveness of implementing a nutrition intervention was evaluated using a general nutrition class to promote the consumption of fruits and vegetables in college students by Ej et al. [36]. The nutrition knowledge intervention was documented to improve the intake of fruits and vegetables and decrease the intake of French fries [36], further supporting the notion that nutrition education can exert a positive effect in shaping healthful dietary habits in college young adults. According to a previous study in a college setting among students without formal nutrition instruction, better nutrition knowledge was negatively correlated with fat and cholesterol intake. Students who consumed more than 35% of their energy from fat or over 300 mg of cholesterol daily exhibited lower mean nutrition scores compared to students with lower fat or cholesterol intake, indicating a correlation between poor nutrition habits in relation to fat consumption and suboptimal nutrition knowledge [37]. The findings reported here reveal a similar trend whereby the nutrition students consumed less fat than non-nutrition students, although our results in terms of fat consumption specifically were not statistically significant.

In a separate study, researchers showed that taking a nutrition course may decrease fat consumption in first-year students, which may improve diet quality and decrease the risk of chronic disease related to fat consumption [38], without demonstrating, however, a global effect on diet quality. In our study, protein intake, while not significant, showed higher results for nutrition students compared to non-nutrition students. Moreover, the consumption of eggs was observed to be significantly higher in nutrition students, potentially indicating a preference for protein of higher quality and biological value. Collectively, from a dietary behavior perspective, the trends seen in nutrition students for both fat and protein consumption are in the desirable direction. Additionally, water intake was higher in nutrition students, indicating another positive behavior/practice in relation to a higher level of nutrition literacy. Adequate hydration is associated with positive health outcomes, while water is the preferred source of hydration according to advisory boards and agencies responsible for issuing dietary guidelines in different countries [39].

In the work presented herein, it was found that nutrition knowledge produces a healthier dietary pattern, even when there are no significant differences in body composition and anthropometry, although the body composition parameters were more favorable for the students with better nutrition knowledge. This is an important observation because considering that this is a young population and dietary habits tend to exert a cumulative effect over time, such a trend should not be underestimated or overlooked, since small but persistent changes in energy intake can have significant implications over time. Specifically, research with young adults has underlined the potential of small improvements in diet quality over time as a probable contributor to minimizing weight gain [40]. Moreover, it has been shown that young adults on weight prevention programs struggle to lose weight and/or maintain weight loss [41]. In this context, prevention becomes even more critical in terms of ideally not reaching a point whereby an intervention for weight loss/management is needed. Both small and larger changes (depending on the individual), always based on nutrition knowledge and practical application, have been shown to be effective towards weight gain prevention/management in young adults [42,43].

Regarding micronutrient intake, nutrition students achieved significantly higher levels of intake for certain vitamins (pantothenic acid and biotin) and minerals (potassium, calcium, and iodine), with such intakes approaching more closely, yet not necessarily meeting, the recommended dietary intakes. The higher potassium intake in nutrition students seems to agree with the respective consumption of fruits and vegetables, although other foods can be rich potassium sources. Overall, the intakes of the above vitamins and minerals, closer to the dietary recommendations, indicate better diet quality in the more nutrition-literate group and better compliance with dietary guidelines. Notably, the prevalence of iodine deficiency in pregnant females as well as their newborns was documented to be alarmingly high in a recent cross-sectional national survey in Turkey [44]. Hence, nutrition education can potentially exert specific and timely benefits in terms of preventing nutrient

deficiencies in females of reproductive age, with far-reaching consequences during a period of epidemiological/nutrition transition.

The strengths of our study include the clear differentiation of nutrition knowledge achieved between NS and NNS participants, as well as the investigation of an understudied population (female college students in Turkey). The limitations of the study may include the convenience mode of sample selection, the sample size, and the age and educational levels of participants, raising concerns about generalizability to the wider population. Another limitation of this study is that it is a cross-sectional pilot study. Improvements for future directions may include the design of longitudinal studies to determine the association between nutrition knowledge and dietary habits, while also including a more diverse and extensive population. An advantage of this work in the context of a more traditional society undergoing an epidemiological transition, such as that of Turkey, is that it illustrates the importance of nutrition education in the young female population, with significant public health implications.

## 5. Conclusions

The study presented here demonstrates that, in female college students in Turkey, nutrition knowledge is positively associated with a significantly increased intake of fruits, vegetables, grains, fiber, and water, as well as a lower carbohydrate intake. Moreover, positive trends in terms of lower intake of fat but higher intake of protein were also observed for the more nutritionally knowledgeable students. Additionally, body composition was marginally more favorable for nutrition-knowledgeable students. Finally, higher levels of nutrition knowledge correlated with better intake of certain micronutrients, pointing to the added value of nutrition education towards preventing nutrition-related disease and malnutrition in a nutrition transition setting.

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**Data Availability Statement:** Data are available upon request and approval from the corresponding author, Aleksandra S. Kristo.

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