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INTRODUCTION

Alzheimer's disease (AD) is a neurodegenerative disorder that significantly impacts health and quality of life, affecting millions worldwide. While several theories, such as the cholinergic and amyloid hypotheses, attempt to explain the pathophysiology of AD, none have gained universal acceptance (1-3).

Recent research highlights the role of nutrition in AD (4). Studies suggest that diets high in saturated fatty acids and calories may increase the risk of AD, whereas antioxidants and polyphenols

may reduce it. There is growing interest in the bidirectional connection between the central nervous system and the enteric nervous system, linking brain functions with intestinal health. Intestinal dysbiosis, characterized by an imbalance of harmful bacteria, has been associated with various conditions, including obesity, neuropsychiatric disorders, and neurodegeneration (5,6).

Alterations in gut microbiota have been proposed to contribute to the development and progression of AD. Individuals with AD often show reduced gut microbial diversity, with an overrepresentation of pro-inflammatory bacteria at the expense

Knowledge of the role of nutrition and gut microbiota in Alzheimer's disease among students in the faculty of medicine and the faculty of nutrition and dietetics

Abstract

Aim: This study aimed to assess the knowledge level of students in the Faculty of Medicine and the Faculty of Nutrition and Dietetics at Bahçeşehir University (BAU) regarding the role of nutrition and gut microbiota in Alzheimer's disease (AD).

Materials and Methods: A descriptive research design was employed to measure the knowledge level of first- and second-year students from the Faculties of Medicine and Nutrition and Dietetics at BAU regarding the role of nutrition and gut microbiota in AD. A 23-question questionnaire was administered, divided into five sections: (1) Demographic characteristics, (2) Understanding of AD, (3) Understanding of the relationship between nutrition and AD, (4) Understanding of the relationship between nutrition and gut microbiota, and (5) Understanding of the relationship between gut microbiota and AD. The questionnaire included two types of closed-ended questions: (1) Dichotomous and (2) Multiple-choice questions.

Results: Medical students demonstrated a higher overall knowledge level compared to Nutrition and Dietetics students. However, within both faculties, first-year students exhibited a greater understanding of the relationship between gut microbiota and AD than second-year students.

Conclusion: These findings underscore the importance of early education in establishing a strong knowledge foundation. Addressing these knowledge gaps will better prepare future healthcare professionals to understand the impact of nutrition and gut microbiota on AD.

Keywords: Alzheimer's disease, nutrition, diet, gut microbiota, gut dysbiosis, brain-gut axis

of beneficial ones. This microbial shift, influenced by dietary habits, is linked to neuroinflammation, cognitive decline, and mood disturbances (7).

This study aims to assess the knowledge of first- and second-year students in the Faculties of Medicine and Nutrition and Dietetics regarding the relationship between nutrition, gut microbiota, and their potential role in AD. It also explores the connections between AD and other body systems, expanding research into the digestive system's role in AD.

The research questions guiding this study are:

1. Do first- and second-year medical students understand the relationship between nutrition, gut microbiota, and AD?
2. Do first- and second-year Nutrition and Dietetics students have sufficient knowledge on this topic?
3. Is there a difference in knowledge levels between first- and second-year medical students?
4. Is there a difference in knowledge levels between first- and second-year Nutrition and Dietetics students?

MATERIALS AND METHODS

Research Approach and Design

This non-experimental study employed a quantitative analytical approach to assess the knowledge of first- and second-year students in the Faculties of Medicine and Nutrition and Dietetics at Bahçeşehir University (BAU) regarding the role of nutrition and gut microbiota in AD. The survey questions were adapted from the Alzheimer's Disease Knowledge Scale (ADKS) and supplemented with additional questions based on relevant literature (8). The final questionnaire consisted of 23 questions across five sections: demographics, understanding of AD, knowledge of nutrition and AD, knowledge of nutrition and gut microbiota, and knowledge of gut microbiota and AD.

Population and Participants

Participants were first- and second-year students from the Faculties of Medicine and Nutrition and Dietetics at BAU, selected based on the following inclusion and exclusion criteria.

Inclusion criteria:

1. First- or second-year students at BAU,
2. Enrolled in either the Faculty of Medicine or the Faculty of Nutrition and Dietetics.

Exclusion criteria:

3. Students not in the specified years or departments.
4. Students from other universities.

Sampling Design

Convenience sampling was used to select participants meeting the criteria, facilitating accessibility and increasing participation likelihood.

Sample Size Calculation

A power analysis determined the sample size to be 121 students, divided into four subgroups based on department and year. This calculation accounted for an expected effect size and a statistical power of 0.80 with an alpha level of 0.05, ensuring reliable insights into students' knowledge regarding nutrition, gut microbiota, and AD.

Ethical Considerations

Ethical approval was obtained from BAU's Ethical Board (Approval date: November 10, 2022). Participants received an information sheet detailing the study's goals, their rights, and assurances of anonymity, including the option to withdraw from the study at any time.

Procedures

Data Collection Instruments

The primary data collection instrument was a survey distributed to students in the Faculties of Medicine and Nutrition and Dietetics. The questionnaire included both dichotomous and multiple-choice questions to assess knowledge levels.

Data Collection Procedures

Before data collection began, approval was obtained, and informed consent forms were distributed. Data collection sheets were provided during the initial session to gather demographic data and administer the survey.

Data Analysis Procedures

Data were analyzed using the Statistical Package for Social Sciences (SPSS). Logistic regression analysis and independent samples t-tests were performed for subgroup comparisons. Levene's test was employed to assess the equality of variances, with statistical significance set at $\alpha=0.05$.

Reliability and Validity

The internal consistency of the knowledge assessment tool was measured using Cronbach's alpha, which yielded a value of 0.70, indicating acceptable reliability. This suggests that the questionnaire effectively measured students' knowledge of the relationship between nutrition, gut microbiota, and AD.

Statistical Analysis

Group comparisons were conducted using the Student's t-test for independent samples, with normality confirmed via the Shapiro-Wilk test ($p>0.05$). Statistical significance was set at $p<0.05$, with p-values from t-tests reported as [insert p-values].

RESULTS

A total of 121 participants who met the inclusion criteria were consecutively recruited for the study. All participants completed a questionnaire designed to assess their knowledge about the role of nutrition and gut microbiota in AD. The survey was divided into five main sections, including demographic data (Table 1).

Table 1. Demographic characteristics of the participants

	Discipline	Year
Gender (%)		
Female (66.94)	Medicine (57.02%)	1 st year (30.57%)
Male (33.06)	Nutrition and dietetics (42.97%)	2 nd year (69.42%)

Demographic Data

The first section of the survey included three questions to gather demographic information, such as gender, department, and year of study. The demographic characteristics of the participants are summarized in Table 1 and 2.

Table 2. Group statistics in sections 2, 3, 4, and 5

Section number	Discipline	Year	N	Mean	SD	Standard deviation error mean
Section 2	Medicine	1 st year	12	.5167	.18007	
		2 nd year	57	.5719	.19434	
	Nutrition	1 st year	25	.6240	.18547	.03789
		2 nd year	27	.6593	.18242	.03511
Section 3	Medicine	1 st year	12	.5333	.09847	
		2 nd year	57	.5965	.14388	
	Nutrition	1 st year	25	.5680	.17010	.03402
		2 nd year	27	.5556	.17831	.03432
Section 4	Medicine	1 st year	12	.7500	.09045	
		2 nd year	57	.7544	.15592	
	Nutrition	1 st year	25	.6950	.14283	.02057
		2 nd year	27	.7037	.16980	.03268
Section 5	Medicine	1 st year	12	.8167	.13371	
		2 nd year	57	.7825	.17841	
	Nutrition	1 st year	25	.7520	.13866	.02653
		2 nd year	27	.7431	.23264	.04478

N: number of participants, SD: standard deviation

Understanding Level of Alzheimer’s Disease

This section of the questionnaire included five questions to assess students' understanding of AD in both departments. A total of 121 students participated: 12 first-year medical students, 57 second-year medical students, 25 first-year Nutrition and Dietetics students, and 27 second-year Nutrition and Dietetics students.

The results showed that 4 out of 12 (33.3%) first-year medical students and 8 out of 57 (14.0%) second-year medical students answered all questions in this section correctly. In comparison, 5 out of 25 (20.0%) first-year Nutrition and Dietetics students and 1 out of 27 (3.7%) second-year students answered all questions correctly.

These findings suggest that medical students generally have a better understanding of AD than their Nutrition and Dietetics counterparts, with 17.39% of medical students answering correctly compared to 11.54% of Nutrition and Dietetics students. Interestingly, first-year students in both departments demonstrated higher knowledge levels than their second-year counterparts, indicating that early-year students may have a stronger foundation in this topic. Figure 1 illustrates the total number and percentage of first- and second-year students in each department who answered the entire section correctly.

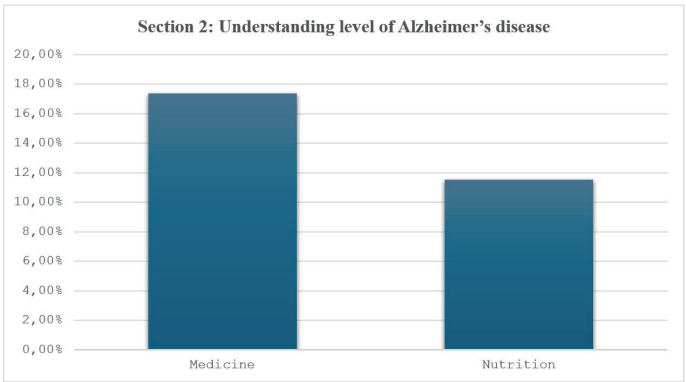


Figure 1. Understanding level of alzheimer’s disease

Understanding Level of the Relationship Between Nutrition and AD

A total of 121 students participated: 12 first-year medical students, 57 second-year medical students, 25 first-year Nutrition and Dietetics students, and 27 second-year Nutrition and Dietetics students. The results showed that 3 out of 12 (25.0%) first-year medical students and 11 out of 57 (19.3%) second-year medical students answered all questions in this section correctly. In contrast, 7 out of 25 (28.0%) first-year Nutrition and Dietetics students and 5 out of 27 (18.52%) second-year students answered all questions correctly.

These findings suggest that Nutrition and Dietetics students performed better overall, with 23.08% answering correctly compared to 20.29% for medical students. Additionally, first-year students in both departments demonstrated greater knowledge about the relationship between nutrition and AD than their second-year counterparts. Figure 2 illustrates the total number and percentage of first- and second-year students from each department who answered all questions correctly.

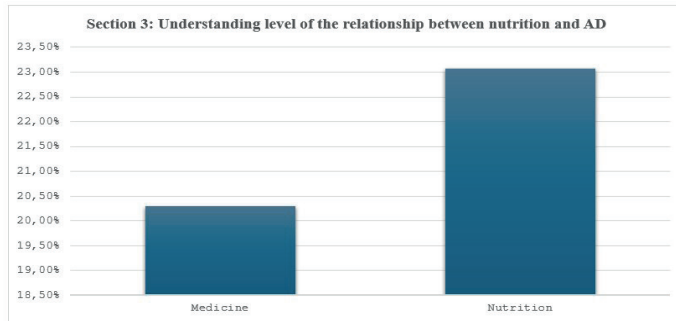


Figure 2. Understanding level of the relationship between nutrition and AD

Understanding Level of the Relationship Between Nutrition and Gut Microbiota

This section of the questionnaire consisted of five questions aimed at assessing students' understanding of the relationship between nutrition and gut microbiota. A total of 121 students participated: 12 first-year medical students, 57 second-year medical students, 25 first-year Nutrition and Dietetics students, and 27 second-year Nutrition and Dietetics students.

The results showed that 3 out of 12 (25.0%) first-year medical students and 8 out of 57 (14.0%) second-year medical students answered all questions in this section correctly. In comparison, 8 out of 25 (32.0%) first-year Nutrition and Dietetics students and 8 out of 27 (29.63%) second-year students answered all questions correctly.

These findings indicate that Nutrition and Dietetics students have a better understanding of the relationship between nutrition and gut microbiota, with a total correct answer percentage of 30.77% compared to 15.94% for medical students. Additionally, first-year students in both departments demonstrated greater knowledge on this topic than their second-year counterparts.

Figure 3 illustrates the total number and percentage of first- and second-year students from each department who answered all questions correctly.

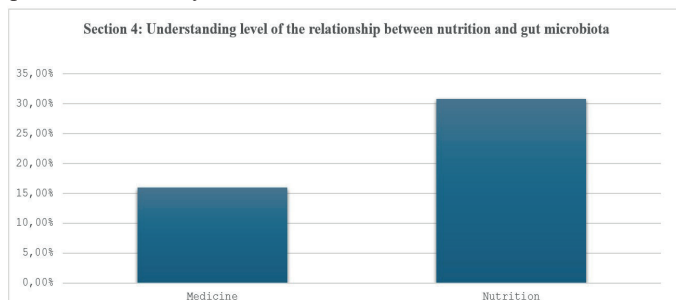


Figure 3. Understanding level of the relationship between nutrition and gut microbiota

Understanding Level of the Relationship Between Gut Microbiota and AD

This section of the questionnaire comprised five questions designed to assess students' understanding of the relationship between gut microbiota and AD. A total of 121 students participated: 12 first-year medical students, 57 second-year medical students, 25 first-year Nutrition and Dietetics students, and 27 second-year Nutrition and Dietetics students.

The results revealed that 6 out of 12 (50.0%) first-year medical students and 26 out of 57 (46.61%) second-year medical students answered all questions in this section correctly. In comparison, 10 out of 25 (40.0%) first-year Nutrition and Dietetics students and only 3 out of 27 (11.11%) second-year students answered all questions correctly.

These findings suggest that medical students have a better understanding of the relationship between gut microbiota and AD, with a total correct answer percentage of 46.38% for both medical years, compared to 25.0% for Nutrition and Dietetics students. Additionally, first-year medical students demonstrated greater knowledge of this relationship than their second-year counterparts. Similarly, first-year Nutrition and Dietetics students outperformed their second-year peers in this area.

Figure 4 illustrates the understanding levels regarding the relationship between gut microbiota and AD among the different student groups.

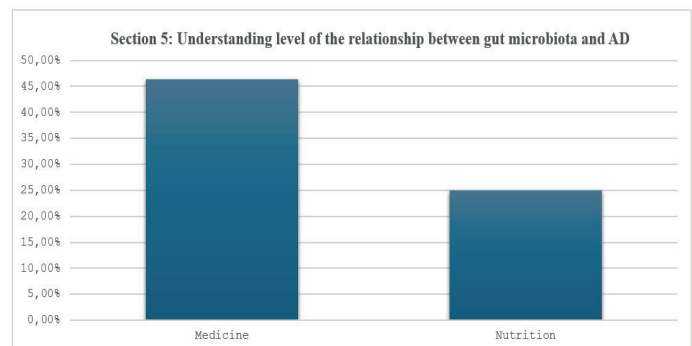


Figure 4. Understanding level of the relationship between gut microbiota and AD

Groups Statistics

This table presents the results of a study assessing the knowledge levels of first- and second-year students from the Faculty of Medicine and the Faculty of Nutrition and Dietetics regarding the relationship between nutrition, gut microbiota, and AD. For each section, the table displays gender, year of study, number of participants (N), mean, standard deviation (SD), and standard error of the mean (SEM). These data allow for a comparison of knowledge between medical and nutrition students, providing insights into the effectiveness of their respective educational programs and highlighting potential gaps in knowledge.

DISCUSSION

Despite significant advances in healthcare in developed countries, the number of individuals diagnosed with AD continues to rise.

Historically, most hypotheses surrounding AD have focused on dysfunctions within the brain and nervous system. However, recent studies have begun exploring potential links between AD and dysfunctions in other bodily systems, particularly the digestive system, opening new avenues for treatment.

The role of gut microbiota in AD has garnered increasing attention, as diet quality throughout life significantly influences gut health (9). Although research into this connection is expanding, knowledge among medical professionals remains insufficient, underscoring the need for greater emphasis on this area and encouraging further research.

Previous studies have highlighted gaps in AD knowledge among medical professionals. For example, a 2013 cross-sectional study comparing first-year and graduating medical students found significant differences in their understanding of AD diagnosis and treatment between primary care physicians and neurologists. With the projected increase in AD cases and its associated healthcare costs, this gap is particularly concerning. An online survey of 343 participants using the 12-item University of Alabama at Birmingham AD Knowledge Test for Health Professionals revealed that final-year medical students lacked essential knowledge about AD (10).

Similarly, a 2017 cross-sectional study conducted by researchers at Kathmandu Medical College assessed AD knowledge among 85 first-year and 105 final-year medical students, using purposive sampling. The study revealed that overall knowledge about dementia was average, with final-year students scoring higher than first-year students. Those who had taken courses or been exposed to dementia through media demonstrated significantly better knowledge (11).

Another cross-sectional survey assessed 124 healthcare staff members at a tertiary care hospital using the ADKS. The study found that hospital staff had insufficient knowledge about AD, but recognized the need for dementia-specific training to improve their understanding (12).

A separate study involving 321 health and social care undergraduates tested their AD knowledge using the ADKS. The results highlighted common misconceptions about AD, with significant gaps found between various student populations, emphasizing the need for enhanced dementia education in health and social care curricula (13).

Research also shows that factors such as diet and gut microbiota are key to exploring the broader implications of AD beyond just neurological considerations (9,14-16). For instance, diets high in saturated fats and calories are associated with an increased risk of AD, while antioxidants and polyphenols have been found to lower that risk (13). Similarly, intestinal dysbiosis—an imbalance in gut bacteria—has been suggested as a contributing factor to AD, with studies showing that people with AD tend to have less diverse gut microbiota, particularly an imbalance between pro-inflammatory and anti-inflammatory bacteria (15,17).

This study examined the knowledge levels regarding the role

of nutrition and gut microbiota in AD among students in the Faculty of Medicine and the Faculty of Nutrition and Dietetics. The findings provide valuable insights into the comparative knowledge levels between these two groups. Notably, the results indicate that medical students exhibited a higher overall knowledge level in this area compared to their counterparts in the Nutrition and Dietetics department. The total percentage of correct answers among medical students from both years was higher than that of Nutrition and Dietetics students. These results suggest that the curriculum and training in the medical department may offer more comprehensive education on the relationship between nutrition, gut microbiota, and AD.

However, a closer examination of the data reveals a more nuanced understanding of the results. When comparing first-year students with second-year students within both faculties, it was found that first-year medical students exhibited a greater understanding of the relationship between gut microbiota and AD than their second-year counterparts. Similarly, first-year Nutrition and Dietetics students demonstrated a higher level of knowledge in this area compared to second-year students. These findings suggest that the early stages of education in both faculties may provide a stronger foundation for understanding the link between nutrition, gut microbiota, and AD.

It is important to note that these results are specific to the study participants from Bahçeşehir University, Istanbul, and caution should be exercised when generalizing them to other university populations. The limitations of the study, such as potential biases introduced by random and voluntary participation, reliance on self-reported evaluations, and the restricted sample from a single geographic region, should be taken into account when interpreting the findings.

To further enhance knowledge in this area, targeted educational interventions should be integrated into the curricula of both the Faculty of Medicine and the Faculty of Nutrition and Dietetics. This could include more comprehensive courses on the role of nutrition and gut microbiota in AD, fostering interdisciplinary collaboration between the two faculties, and providing opportunities for active learning and discussion. Future research should aim to increase sample diversity by including participants from various institutions and geographical regions to enhance the generalizability of the findings.

In conclusion, this study highlights the knowledge levels regarding the role of nutrition and gut microbiota in AD among students in the Faculty of Medicine and the Faculty of Nutrition and Dietetics. While medical students demonstrated a higher overall knowledge level, the findings emphasize the importance of early education and the potential for further improvement in both faculties. By addressing the study's limitations and incorporating targeted educational interventions, future healthcare professionals can be better equipped to understand and address the impact of nutrition and gut microbiota on AD.

The significance of evaluating first- and second-year students' knowledge in medicine and nutrition regarding nutrition, gut

microbiota, and their role in AD includes:

1. **Bridging the Gap:** This study assesses the existing knowledge of early-stage students, providing insights into the effectiveness of the curriculum in covering nutrition, gut microbiota, and AD. It helps identify areas that may need improvement.
2. **Emerging Field:** The link between nutrition, gut microbiota, and AD is a rapidly growing area of research. Evaluating student knowledge highlights awareness levels and potential gaps in medical and nutrition education.
3. **Public Health Impact:** AD is a major public health concern, with the number of affected individuals expected to rise. Understanding the role of nutrition and gut microbiota in AD development is essential for preventive strategies, enhancing the preparedness of future healthcare professionals.
4. **Interdisciplinary Approach:** Collaboration between the medicine and nutrition departments is crucial, as nutrition influences gut health and is linked to neurological disorders like AD. This study promotes an integrated approach to addressing complex health issues.
5. **Educational Enhancement:** The findings can inform curriculum enhancements in both faculties, ensuring that future healthcare professionals receive comprehensive training on the relationship between nutrition, gut microbiota, and AD.

In summary, this study aims to enhance education and awareness among future healthcare professionals about the relationship between nutrition, gut microbiota, and AD, providing valuable insights for curriculum development and public health interventions.

This thesis examined the knowledge levels of students in the Faculty of Medicine and the Faculty of Nutrition and Dietetics regarding the role of nutrition and gut microbiota in AD. The findings underscore that AD is a complex neurodegenerative disorder with multifactorial causes, where nutrition and gut microbiota may play significant roles in its prevention and management.

Medical students demonstrated a higher overall knowledge than their Nutrition and Dietetics counterparts, suggesting a more comprehensive education in the medical curriculum. However, first-year students in both departments exhibited a greater understanding of the gut microbiota-AD relationship than second-year students, highlighting the importance of early education.

Caution is advised when generalizing these findings due to limitations such as potential bias from voluntary participation, reliance on self-reported data, and a geographically restricted sample. Future research should aim for a more diverse and representative sample, while encouraging interdisciplinary collaboration to enhance education and understanding in this area.

CONCLUSION

In summary, this thesis contributes to the understanding of the role of nutrition and gut microbiota in AD among students. It underscores the need for improved educational interventions to better prepare future healthcare professionals.

Recommendations

Future research should aim to increase sample diversity by including participants from various backgrounds and institutions. A mixed-methods approach, combining quantitative and qualitative data, could offer deeper insights into students' understanding of the relationship between nutrition, gut microbiota, and AD. Collaborative efforts among universities would capture a broader range of perspectives. Additionally, interactive workshops could enhance student engagement and learning. Extending the data collection period may also improve sample size and representativeness.

Limitations

This study has several limitations:

1. **Participant Selection Bias:** Random and voluntary participation may not accurately represent the broader student population.
2. **Self-Reported Data:** Reliance on self-reported surveys may introduce bias and affect data accuracy.
3. **Limited Geographic Diversity:** All participants were from Bahçeşehir University, limiting the generalizability of the findings.
4. **Online Class Challenges:** Reduced face-to-face interaction, due to online learning, may have hindered deeper exploration of ideas.
5. **Departmental Imbalance:** Uneven representation between departments may have affected the conclusions.
6. **Time Constraints:** The limited time frame reduced the sample size and diversity of perspectives.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

Ethical approval was obtained from BAU's Ethical Board (Approval date: November 10, 2022). Participants received an information sheet detailing the study's goals, their rights, and assurances of anonymity, including the option to withdraw from the study at any time.

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