Makara Journal of Health Research

Volume 28
Issue 3 *December*

Article 4

12-31-2024

Association between Knowledge, Attitude, and Practice on Dietary Fiber Intake and Body Mass Index among Undergraduate Students in Universiti Kebangsaan Malaysia

Arimi Fitri Mat Ludin
Center for Healthy Ageing and Wellness, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia, arimifitri@ukm.edu.my

Munirah Ismail
Center for Healthy Ageing and Wellness, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia, munirahismail@ukm.edu.my

Mohd Sham Othman
Center for Toxicology & Health Risk Studies & Programme of Environmental and Occupational Health, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia, mso@ukm.edu.my

Divya Vanoh
Programme of Dietetic, School of Health Sciences, Universiti Sains Malaysia, Kelantan16150, Malaysia, divyavanoh@usm.my

Chai Huoy Tyng
Programme of Biomedical Science, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia, tynglynleo1999@gmail.com

Recommended Citation

Mat Ludin AF, Ismail M, Othman MS, Vanoh D, Ibrahim D, Tyng CH, et al. Association between Knowledge, Attitude, and Practice on Dietary Fiber Intake and Body Mass Index among Undergraduate Students in Universiti Kebangsaan Malaysia. Makara J Health Res. 2024;28.

Association between Knowledge, Attitude, and Practice on Dietary Fiber Intake and Body Mass Index among Undergraduate Students in Universiti Kebangsaan Malaysia

Authors

Arimi Fitri Mat Ludin, Munirah Ismail, Mohd Sham Othman, Divya Vanoh, Chai Huoy Tyng, Irdina Ibrahim, Jasmine Lavang Surang, Muhammad Adam Jayiddin, Noor Afiifah Ibrahim, Nur Arina Shazrina Abdullah, Nur Athirah Harun, Nur Fatihah Rashidi, and Lew Leong Chen

Makara J Health Res. 2024;28(3):180–186
doi: 10.7454/msk.v28i3.1667

Makara Journal of Health Research

Association between Knowledge, Attitude, and Practice on Dietary Fiber Intake and Body Mass Index among Undergraduate Students in Universiti Kebangsaan Malaysia

Arimi Fitri Mat Ludin[1,2], Munirah Ismail[1,3*], Mohd Sham Othman[4], Divya Vanoh[5], Chai Huoy Tyng[2], Irdina Ibrahim[2], Jasmine Lavang Surang[2], Muhammad Adam Jayiddin[2], Noor Afiifah Ibrahim[2], Nur Arina Shazrina Abdullah[2], Nur Athirah Harun[2], Nur Fatihah Rashidi[2], Lew Leong Chen[1,2]

[1]Center for Healthy Ageing and Wellness, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia

[2]Programme of Biomedical Science, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia

[3]Programme of Dietetic, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia

[4]Center for Toxicology & Health Risk Studies & Programme of Environmental and Occupational Health, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia

[5]Programme of Dietetic, School of Health Sciences, Universiti Sains Malaysia, Kelantan16150, Malaysia

Abstract

Background: A fiber-rich diet lowers the risk of various diseases by increasing fecal bulk, shortening intestinal transit time, and stimulating intestinal flora. This study examines the association between knowledge, attitude, and practice (KAP) regarding dietary fiber intake and body mass index (BMI) among Dentistry and Software Engineering undergraduates.

Methods: This cross-sectional study included 95 Dentistry and 92 Software Engineering students at the Universiti Kebangsaan Malaysia. The KAP questionnaire was analyzed for its reliability using Cronbach's alpha and distributed through email.

Results: Most respondents had normal weight. The Software Engineering students had a higher percentage of overweight and obese individuals than the Dentistry students. KAP measurements for both groups were moderate across all variables. No differences were found in attitude and practice levels between both groups. However, the Software Engineering students had higher knowledge of dietary fiber intake. KAP did not influence BMI in both groups. Factor analysis showed a high association between KAP on dietary fiber intake and BMI status among Software Engineering students compared to dentistry students.

Conclusions: The level of KAP on dietary fiber intake is associated with BMI status among undergraduate students.

Keywords: attitude, body mass index, dietary fiber, knowledge, practice

INTRODUCTION

Dietary fiber is a ubiquitous component of plant foods, which includes materials of diverse chemical and morphological structures resistant to the action of human alimentary enzymes.[1] It can be found in all plant-derived foods such as fruits, vegetables, nuts, whole grains, and legumes.[2] According to the World Health Organization (WHO), the recommended dietary fiber intake is at least 400 g or 5 daily portions of fruit and vegetables. The National Research Council (US) Committee on Diet and Health concluded that consuming a diet high in fiber prevents the development of various chronic diseases such as coronary disease, diabetes mellitus, diverticulosis, hypertension, and gallstone.[3] Therefore, increasing the consumption of foods high in fiber induces various health benefits.

The relationship between dietary fiber intake and body mass index (BMI) has been explored across various demographics, revealing significant insights into how fiber consumption may influence weight management. Research revealed that higher fiber intake is associated with lower BMI. Studies showed that higher fiber intake is linked to lower BMI in children[4] and physically active adults.[5]

However, the intake of essential forms of dietary fiber has been found to be inadequate among university students from three different continents.[6] This is probably due to the students' eating habits that do not adhere to the suggested dietary standards because of financial and food accessibility issues and time constraints. Many students are aware of the health advantages of dietary fiber consumption; however, the number of individuals

***Corresponding author:**
Munirah Ismail
Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia
E-mail: munirahismail@ukm.edu.my

who do not eat high-fiber meals remains significant. The participants of a study among Polish medical students demonstrated improper nutritional habits and eating patterns that did not comply with the Polish food-based dietary guidelines.[7] In another study, only 10% of pharmacy and medical students in California achieved the recommended daily fruit and vegetable intake.[8] Low dietary fiber intake is evident even among students enrolled in health-related programs, further indicating that they have poor dietary fiber intake. This shows that their personal decisions contradict their judgment of the efficacy of their dietary education.

Dietary fiber intake is notably inadequate among college students in Malaysia, with various studies highlighting significant shortfalls compared to recommended levels. A study indicated that 84.6% of Malaysian adults, including university students, consume below the daily recommended 25 grams of dietary fiber.[9] In another study, while students met macronutrient intake levels, their fiber and micronutrient consumption was insufficient and was linked to higher BMI and body fat percentage among students.[10] In a more recent report, male students were found to have lower fiber intake, which correlated with higher BMI readings; however, this trend was not observed in female students.[11] This report corroborates the earlier finding by Razak *et al*.,[12] which showed that the prevalence of overweight was notably higher in males (46.5%) than in females (17.4%). The findings underscore the need for targeted health promotion strategies to increase dietary fiber intake, particularly among male students, to combat rising obesity rates.

Promoting adequate fiber intake is beneficial for digestive health and plays a crucial role in weight management and maintenance of a healthy BMI. Notably, an individual's BMI is influenced by several factors. However, promoting adequate fiber intake leads to significant cost savings in disease prevention owing to its association with reduced healthcare expenditures and improved health outcomes. Studies in the United States[13] and Canada[14] showed that increased daily dietary fiber consumption could substantially save healthcare cost, especially for cardiovascular disease management. Understanding the existing link between fiber intake and BMI among college students provide empirical evidence for promoting dietary fiber. Integrating this knowledge into public health campaigns potentially reduces healthcare costs associated with NCDs.[15]

Dietary fiber intake was believed to be influenced by an individual's knowledge, attitude, and practice (KAP) toward dietary fiber intake and health. The decline in dietary fiber intake may be due to false perceptions, such as dietary fiber meals being expensive and less available and offering fewer health benefits, or simply disliking the taste. This study evaluates the effect of KAP on dietary fiber intake among undergraduates using validated questionnaires for determining the differences in the level of KAP on dietary fiber intake and further investigates the association between BMI and KAP among Dentistry and Software Engineering students.

METHODS

Approval from the human research ethics board was obtained from the Medical Research and Ethics Committee of Universiti Kebangsaan Malaysia (UKM PPI/111/8/JEP-2021-504) prior to data collection. Data collected, including the names, addresses, and telephone numbers of the participants, were kept confidential. Each participant was asked to read and sign a consent form that informed about the purpose of the study before the questionnaire was administered.

A cross-sectional study was performed among Dentistry and Software Engineering with Information System Development undergraduate students at the University Kebangsaan Malaysia (UKM). The dentistry students were located at the campus with health-related academic programs and the Software Engineering students at the main campus where all programs were non-health related. Regardless of the location, both programs had limited formal nutritional-related modules in their curricula. These two programs were located on different campuses in two different states. The total number of students were identical, which eased the recruitment process. Students who were married, pregnant, and under long-term medications and those with chronic diseases were excluded. The sample size was calculated using the Krejcie Morgan formula, and stratified random sampling was employed. First, students from both programs were classified according to year of study followed by sex. Each stratification was proportionately represented. Overall, 187 undergraduates were enrolled in this study. A total of 95 from the Dentistry program and 92 from the Software Engineering with Information System Development program were selected as the respondents.

A validated KAP on dietary fiber by Daud *et al*.[2] was transformed into online questionnaires using Google Form, which was then distributed to selected participants through email. The questionnaire was divided into three sections. In the first section, participants were required to fill in the demographic details, including age and study year. In the second section, they were asked to self-report their weight in kilograms and height in meters. The participants were reminded to measure their body weight in case they were unsure about their latest body weight. BMI was calculated by dividing weight in kilograms with height in meter squared, and BMI status was determined by using the WHO criteria, in which at the time of study execution, the Malaysian Ministry of Health also employed the same classification. In the third section, the participants were required to answer the

KAP questionnaires. The KAP questionnaire was pretested among 30 students from the same institution, but from different programs than those of the actual study participants. Then, the reliability of the questionnaire was analyzed using Cronbach's Alpha analysis. Furthermore, this questionnaire was used to evaluate the KAP of UKM undergraduates toward the importance of dietary fiber intake. The scoring system was calculated using an interquartile range method: the low score was calculated by multiplying 25% with the total KAP value, the medium score was obtained by multiplying 75% with the total KAP value, and the high score was the whole value of KAP. The range of low, moderate, and high scores were determined with a score less than the value calculated via the method mentioned above.

The knowledge domain included 14 "true" and "false" and 10 "yes" and "no" questions. The "true" and "yes" answers were labeled with 1 point and the "false" and "no" answers with 0 point. The score for each question was categorized as low, moderate, or high: high score, 37–48 points: middle score, 13–36 points; and low score, ≤12 points. In the attitude domain, 12 questions about dietary fiber intake were accessed based on a 5-point Likert scale, which consisted of "strongly disagree," "disagree," "neutral," "agree," and "strongly agree." The score for each question was categorized as low, medium, and high (negative scale, 0 point; neutral, 1 point; and positive scale, 2 points). The scores were summed up to derive a composite continuous score for the attitude domain. Descriptively, the high score ranged from 46 to 60 points, the middle score from 16 to 45 points, and the low score 15 and below. Finally, the practice domain consisted of 13 questions with "yes" and "no" options, and the scoring system was similar to that of the knowledge domain.

Data collected were analyzed using Statistical Package for the Social Sciences software version 26.0. Descriptive statistics were used to evaluate the sociodemographic profile of participants and determine the KAP on dietary fiber intake and BMI. Two-way analysis of variance (ANOVA) was employed to compare KAP on dietary fiber intake and BMI status between students enrolled in the Dentistry and Software Engineering undergraduate programs according to the year of study. The relationship between KAP on dietary fiber intake and BMI status among undergraduate students was determined using multiple linear regression tests.

RESULTS

Overall, 183 participants completed and returned the questionnaires. Among them, 95 were from the Dentistry program and the rest from the Software Engineering program. The respondents included 118 Malays, 36 Chinese, 21 Indians, and 8 from another ethnicity. The results showed that the reliability for the KAP scores was good in that the Cronbach's α for KAP were 0.733, 0.814, and 0.736, respectively, for each domain. Most of the respondents from both programs had a normal weight. However, overweightness and obesity were more prevalent among the Software Engineering students compared to the Dentistry students (Table 1).

Overall, knowledge on dietary fiber intake of students from both programs was moderate (Table 2). The Software Engineering students had significantly higher knowledge on dietary fiber intake than the Dentistry students. Additionally, the scores for attitude and practice toward dietary fiber intake were moderate in both programs. However, no significant differences were noted in the attitude and practice between the two groups of students.

TABLE 1. Sociodemographic and descriptive outcome measures of KAP on fiber among Dentistry and Software Engineering students (N = 183)

Variable	N	Dentistry N (%)	Software Engineering N (%)
Sex			
Female	72	23 (24.2)	49 (55.7)
Male	111	72 (78.8)	39 (44.3)
Ethnicity			
Malay	118	46 (48.4)	72 (81.9)
Chinese	36	28 (29.5)	8 (9.1)
Indian	21	14 (14.7)	7 (8.0)
Others	8	7 (7.5)	1 (1.1)
Year of study			
First	48	26 (27.4)	22 (25.0)
Second	35	17 (17.9)	18 (20.5)
Third	54	26 (27.4)	28 (31.8)
Fourth	46	26 (27.4)	20 (22.7)
BMI status			
Underweight	24	14 (14.7)	10 (11.4)
Normal weight	121	71 (74.7)	50 (56.8)
Overweight	32	9 (9.5)	23 (26.1)
Obesity	6	1 (1.1)	5 (5.7)
Knowledge on dietary intake			
High	183	16 (16.8)	30 (34.1)
Moderate		79 (83.2)	58 (65.9)
Attitude on dietary fiber intake			
High	183	28 (29.5)	16 (18.2)
Moderate		67 (70.5)	72 (81.8)
Practice on dietary fiber intake			
High	183	66 (69.5)	76 (86.4)
Moderate		29 (30.5)	12 (13.6)

TABLE 2. KAP score (%) toward dietary fiber intake among Dentistry and Software Engineering undergraduates

Variable	Total (N = 183)	Dentistry (N = 95)	Software Engineering (N = 88)	*p*
Knowledge on dietary fiber intake	32.5 ± 5.4	31.3 ± 5.2	33.8 ± 5.3	0.001
Attitude on dietary fiber intake	43.6 ± 5.4	44.4 ± 5.8	42.7 ± 5.0	0.052
Practice on dietary fiber intake	21.0 ± 2.0	20.6 ± 2.2	21.2 ± 2.0	0.145

TABLE 3. Relationship between knowledge, attitude, and practice on dietary fiber intake and BMI status among Dentistry and Software Engineering undergraduates

	BMI (r)	*p*
Knowledge	0.050	0.585
Attitude	0.072	0.435
Practice	0.155	0.095

In stepwise multiple regression, the 4.3% and 5.4% variations in BMI of Dentistry students and Software Engineering students, respectively, can be explained by KAP on dietary fiber intake. ANOVA showed that the equation model for the Dentistry students as a whole is not significant in predicting BMI. A similar conclusion can be derived for the Software Engineering students. KAP were not significantly associated with BMI in the multivariate analysis. This means that knowledge, attitude, and practice on dietary fiber intake (independent variables) cannot influence the BMI (dependent variable) of students of both programs. Table 3 summarizes the results.

DISCUSSION

The rural and urban adolescents in Malaysia generally have moderate knowledge on the source and role of dietary fiber intake, but less knowledge on the recommended dietary fiber intake.[2] The current study shows that the level of association between KAP on dietary fiber intake and BMI among Dentistry and Software Engineering undergraduates were high or moderate, and no low scores were recorded. However, the finding from this study was not consistent with that from a study by Bergeron *et al*.,[8] wherein Dentistry study participants showed higher KAP knowledge compared to Software Engineering participants.

The high scores can be due to various reasons such as the social environment of the students with the family, friends, and lecturers. This could provide more resources and reinforce their understanding of dietary fiber intake, which in turn enhances general knowledge. Moreover, the Internet is a convenient platform for obtaining nutritional information. Most young adults spend more than 3 hours each day playing video games and using social media sites such as Facebook and Twitter, and social media exposes them to various information that affects their lifestyle choices.[16,17] Thus, they may have access to a wide range of resources about nutrition.[2] Moreover, Informatics Engineering students have demonstrated good levels of information, media, and computer literacy, indicating a strong foundation for digital health literacy.[18] A recent study reported that digital health literacy is associated with improved health knowledge.[19]

Corresponding to the exposure of knowledge on health among Dentistry students, their attitude toward dietary fiber intake is higher than that of Software Engineering students. Although there is no formal module related to nutrition in their curriculum, being surrounded by peers from Nutrition and Dietetics programs may indirectly benefit them. The Dentistry faculty is located in the same campus as the Health Sciences faculty, which offers Nutrition and Dietetics programs. This may explain the small margin of better score attitude toward fiber intake among Dentistry students. However, the proportion of those who scored high for both programs was low. This may be due to the lack of knowledge as compared to postgraduate students, as they are still learning and gaining knowledge.

The lack of a significant difference between these two groups of students can be explained by the possibility of food insecurity. A study across eight universities in the United States showed that 19%–34% of the respondents were affected by food insecurity.[20] Food-insecure students tend to consume fewer fruits and vegetables.[20,21] The habit of eating out[22] and food cost[23] hinder students from eating healthy, regardless of the academic program.

Regarding practice level, Dentistry students showed lower practice scores than the Software Engineering students. This could be because of the schedule differences between both programs. Medical-related programs tend to have a busier schedule, leaving students with inadequate time to have proper meals. This leads to an unhealthy culture of ordering fast food because of its accessibility.[24] The location of the program faculty also plays a role as Dentistry program in UKM is located in the central area within the capital city Kuala Lumpur, whereas the Software Engineering program is located in Bangi, which is a town approximately 40 km south of Kuala Lumpur. Kuala Lumpur may have a higher choice of food options compared to Bangi. Therefore, the Dentistry students may have a higher risk of practicing unhealthy dietary habits as they have greater food choices and have higher exposure to new food cultures. The unhealthy food environment is overwhelming among the young people, leading to poorer dietary intake.[6]

The level of knowledge on dietary fiber intake and BMI between undergraduates enrolled in the Dentistry and Software Engineering programs and study year, respectively, showed no significant difference. This may be because nowadays, with the advancement of technologies, browsing updated information about healthy dietary habits is easier. Furthermore, young people can always find posters and videos on social media platforms, especially from the websites of the Ministry of Health, and awareness programs related to dietary fiber intake. Thus, these can be a reason for no significant difference among respondents based on program and year of study.

The output in comparing levels of attitude toward dietary fiber intake based on year of study showed no significant differences. However, a statistically significant attitude level was observed between study programs. The Dentistry students showed higher scores in the attitude domain as compared to the Software Engineering students. This can be due to the peer influence of the Dentistry students who are sharing the campus with Nutrition and Dietetics students. Thus, they may be exposed to healthy eating habits and may seek dietary advice when warranted. Zhang *et al*.[25] reported that attitude toward healthy eating influences an individual's dietary practice.

The current study determined that most of the Dentistry students had normal BMI compared to the Software Engineering students. Overweightness and obesity were higher among the Software Engineering students compared to the Dentistry students. These findings are consistent with those of a study by Bergeron *et al*.,[5] which found that students in healthcare professional programs are more likely to embrace a healthy lifestyle by maintaining a normal BMI compared to those without health-related knowledge.

Conversely, the present study found that knowledge on dietary fiber intake does not influence the BMI of the studied populations in both programs. This may be due to several barriers such as financial constraints, lack of knowledge, and trend impact. These factors may elucidate why the number of people complying with the dietary fiber intake recommendation remains low. Additionally, this study revealed that practice and attitude on dietary fiber intake of students from both programs were not significant predictors of BMI among the studied population. Despite the health benefits of dietary fiber intake, people still refuse to consume high-fiber meals. This is because of the decreasing intake of wholemeal items in daily diets and the fact that fiber-rich meals are more expensive.[26] Additionally, a study by Eng *et al*. found that low-income adults have unhealthy food intake practices with low intake of fruits and vegetables and high intake of ultra-processed foods and calorie-dense local food, wherein the top reported factor affecting food purchase choices was price (79.4%).[27] Moreover, healthy, good quality, and affordable food choices for Malaysian public university students in university cafeterias or online food delivery applications are limited.[28] A study by Rajikan *et al*.[29] concluded that a nutritionally complete meal was not affordable and rather expensive for low-income students in Malaysia university cafeterias, and students would need to spend more on food to increase consumption of fruit and vegetables.[29] Hence, university management should seek other alternatives in providing more complete yet affordable food for the students to improve their practice on dietary fiber intake.

One of the primary limitations of this study was the reliance on self-reported body weight from participants instead of measurements taken by researchers. Self-reported data can often underestimate or overestimate the actual body weight owing to inaccuracies in recall or social desirability bias. This limitation raises concerns about the reliability of the BMI calculations derived from these reports. Moreover, the participant pool lacked adequate representation from the less dominant ethnic background within the college population. This limitation restricts the generalizability of the findings, as dietary habits and fiber intake can vary significantly across different ethnic groups because of cultural, socioeconomic, and environmental factors. To enhance the robustness of future research on dietary fiber intake, future studies should explore the relationship between dietary fiber intake and food security among college students. Understanding how access to nutritious food influence fiber consumption could provide insights into dietary habits and help develop targeted interventions for students experiencing food insecurity. Furthermore, it is worth considering examining the association between fiber intake and other dietary habits, such as the frequency of eating out and night eating. These factors can significantly influence diet quality and fiber intake levels. Analyzing these relationships may reveal crucial correlations and contribute to a more comprehensive understanding of the dietary behaviors of college students.

CONCLUSIONS

Therefore, no association between KAP on dietary fiber intake and BMI status was observed among the Dentistry and Software Engineering students at UKM. Hence, the research hypothesis was not accepted. Although the actual dietary intake was not obtained, the findings still showed an impact on the level of KAP on dietary fiber intake. Thus, intervention programs should be conducted in the future targeting schools and universities to improve KAP on dietary fiber intake.

CONFLICT OF INTEREST

None declared.

FUNDING

None.

Received: June 22, 2024 | Accepted: November 18, 2024

REFERENCES

1. Dhingra D, Michael M, Rajput H, Patil RT. Dietary fibre in foods: A review. *J Food Sci Technol.* 2012;49:255–66.
2. Daud NM, Fadzil NI, Yan LK, Makbul IAA, Yahya NFS, Teh AH, et al. Knowledge, attitude, and practice regarding dietary fibre intake among Malaysian rural and urban adolescents. *Malays J Nutr*. 2018;24:77–88.
3. Committee on Diet and Health, Food and Nutrition Board, Commission on Life Sciences, National Research Council. *Diet and health: Implications for reducing chronic disease risk*. Washington DC: National Academy Press; 1989.
4. Wada K, Nagata C, Yamakawa M, Nakashima Y, Koda S, Uji T, et al. Association of dietary fibre intake with subsequent fasting glucose levels and indicators of adiposity in school-age Japanese children. *Public Health Nutr*. 2023;26:1617–25.
5. Khawandanah J, Chambers E, Frost G. The role of fibre intake in combination with physical activity in reducing body composition parameters. *Curr Dev Nutr.* 2022;6:1165.
6. García-Meseguer MJ, Delicado-Soria A, Serrano-Urrea R. Fiber patterns in young adults living in different environments (USA, Spain, and Tunisia). Anthropometric and lifestyle characteristics. *Nutrients*. 2017;9:1030.
7. Ilow RA, Regulska-Ilow B, Rozanska D. Dietary habits of Wroclaw Medical University students (Poland). *Rocz Panstw Zakl Hig*. 2017;68:23–32.
8. Bergeron N, Al-Saiegh S, Ip EJ. An analysis of California pharmacy and medical students' dietary and lifestyle practices. *Am J Pharm Educ.* 2017;81:5956.
9. Ibrahim SFKM, Ali A, Kamarudin KS, Ibrahim NH, Hasim AS. Habitual dietary fibre intake and lifestyle characteristics in relation to functional constipation among adults in Malaysia. *Malays Appl Biol*. 2022;51:47–55.
10. Koo HC, Hadirah Z, Airina A, Nurul Alifatul Amrina R, Faziela N. Effect of nutrient intakes on anthropometric profiles among university students from a selected private University in Klang Valley, Malaysia. *Afr Health Sci*. 2019;19:2243–51.
11. Chong CY, Tan CX, Tsai MC, Tan SS, Hariyono H, Tan ST. Gender differences in dietary intake and physical activity among university students: a post-COVID-19 pandemic study. *Nutr Food Sci.* 2024;54:1190–201.
12. Razak MR, Ismail E, Bakar AY. Profiling of physical activity, health fitness (Vo2max), body composition, and dietary intake among malaysian university students: A case study. *Int J Hum Mov Sport Sci*. 2020;8:413–20.
13. Shanahan CJ, Gibb RD, McRorie JW, Brum JM, Ritchey ME. Economic impact analysis of the coronary heart disease-attributed health care cost savings and productivity gains from the use of Psyllium. *Nutr Food Sci*. 2020;50:497–513.
14. Abdullah MM, Gyles CL, Marinangeli CP, Carlberg JG, Jones PJ. Dietary fibre intakes and reduction in functional constipation rates among Canadian adults: A cost-of-illness analysis. *Food Nutr Res*. 2015;59:28646.
15. Tan LK, Lim GP, Koo HC, Ismail MZ, Chan YM, Sulaiman W, Ali O, Kee CC, Omar MA. Association between adequate fruit and vegetable intake and CVDs-associated risk factors among the Malaysian adults: Findings from a nationally representative cross-sectional study. *Int J Environ Res Public Health*. 2022;19:9173.
16. Mun WF, Li LM, Fernandez PR. Social life connects the world: Malaysian youth's usage behaviour of social network sites. *Int J Art Sci Conf.* 2011;4:157–78.
17. Abdullah A, Tahir Z, Yusoff NH, Andrew FT. Effect of social media usage on the lifestyles of youth. *J Soc Sci Humanit*. 2022;19:60–9.
18. Elmunsvah H, Hidayat WN, Patmantara S. Digital literacy skills of informatics engineering education students as the basis for online learning implementation. *Proceedings of the 2018 International Seminar on Application for Technology of Information and Communication*; Semarang, Indonesia; September 21, 2018.
19. Prata RA, Silva JBD, Pimentel SM, Nunes HRC, Avila MAG. Digital health literacy, behavior and knowledge of adolescents for hand hygiene during the COVID-19 pandemic. *Rev Lat Am Enfermagem*. 2024;32:e4308.
20. El Zein A, Colby SE, Zhou W, Shelnutt KP, Greene GW, Horacek TM, et al. Food insecurity is associated with increased risk of obesity in US college students. *Curr Dev Nutr*. 2020;4:nzaa120.
21. Volpe SL. Food insecurity among college students. *ACSMs Health Fit J.* 2019;23:53–4.
22. Rahmawati R, Nurwati I, Wiboworini B. Does eating out cause in overweight and obesity in adolescence? *Proc Int Conf Nurs Health Sci*. 2023;4:281–8.
23. Drzal N, Kerver JM, Strakovsky RS, Weatherspoon L, Alaimo K. Barriers and facilitators to healthy eating among college students: A cross-sectional study. *Nutr Res.* Forthcoming 2024.
24. Gallo LA, Gallo TF, Young SL, Fotheringham AK, Barclay JL, Walker JL, et al. Adherence to dietary and physical activity guidelines in Australian undergraduate biomedical students and associations with body composition and metabolic health: A cross-sectional study. *Nutrients*. 2021;13:3500.
25. Zhang J, Xu AQ, Ma JX, Shi XM, Guo XL, Engelgau M, et al. Dietary sodium intake: Knowledge, attitudes and practices in Shandong Province, China, 2011. *PLoS One*. 2013;8:e58973.
26. Alfawaz H, Khan N, Alhuthayli H, Wani K, Aljumah MA, Khattak MNK, et al. Awareness and knowledge regarding the consumption of dietary fiber and its

relation to self-reported health status in an adult Arab population: A cross-sectional study. *Int J Environ Res Public Health*. 2020;17:4226.
27. Eng CW, Lim SC, Ngongo C, Sham ZH, Kataria I, Chandran A, et al. Dietary practices, food purchasing, and perceptions about healthy food availability and affordability: A cross-sectional study of low-income Malaysian adults. *BMC Public Health*. 2022;22:192.
28. Eu EZR, Sameeha MJ. Consumers' perceptions of healthy food availability in Online Food Delivery Applications (OFD Apps) and its association with food choices among public university students in Malaysia. *Front Nutr*. 2021 Aug 23;8:674427.
29. Rajikan R, Shin LH, Hamid NIA, Elias SM. Food insecurity, quality of life, and diet optimization of low-income university students in Selangor, Malaysia. *Jurnal Gizi dan Pangan*. 2019;14:107–16.