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EXPLORING NUTRITION KNOWLEDGE, PHYSICAL ACTIVITY, AND DIETARY INTAKE AMONG VIETNAMESE UNIVERSITY STUDENTS

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Abstract

University student lifestyles in Vietnam involve time pressure, convenience food access and irregular physical activity that shape diet quality. Vietnam is also in a nutrition transition with a double burden of malnutrition that includes persistent underweight alongside emerging overweight. This cross-sectional study explored the associations between nutrition knowledge, physical activity, and diet quality among 280 Vietnamese university students aged 18–25 from urban areas. Participants completed validated surveys, including the General Nutrition Knowledge Questionnaire (translated and adapted for the Vietnamese context), the International Physical Activity Questionnaire, and the Diet Quality Questionnaire to assess food group intake and overall diet quality scores. Results indicated moderate nutrition knowledge levels, with frequent consumption of refined grains, processed meats, and sugar-sweetened beverages, alongside suboptimal intake of protective foods like fruits, vegetables, and legumes. Weekly physical activity was moderate, and multiple linear regression analyses, using continuous predictors, revealed that higher physical activity MET-minutes per week (β=0.0029, $p<0.001$), age (β=0.1284, p=0.005), and nutrition knowledge scores (β=0.1102, p=0.014) significantly predicted better GDR diet quality scores, whereas sex did not. These findings suggest that knowledge and active lifestyles together drive behavioral change, with age playing a role in improved diet quality. Programs promoting physical activity and campus-based healthy food access could foster nutritious choices. Limitations include reliance on self-reported data, potential recall bias, and limited generalizability due to the urban cohort. Academically, this study pioneers the application of the Diet Quality Questionnaire in Vietnamese university students, contributing novel insights into lifestyle factors amid rising non-communicable diseases and informing targeted interventions for this vulnerable group.

Keywords: Nutrition knowledge, diet quality, physical activity, university students, vietnam

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1. INTRODUCTION

Vietnam has undergone a rapid epidemiological transition, marked by sustained economic growth, urbanisation, and a shift from infectious to chronic disease burdens (Nguyen and Trevisan 2020). In parallel, diets have moved away from traditional staples and home-prepared meals toward convenience foods, with measurable socio-economic gradients in food choice and nutrient profiles between 2004 and 2014 (Trinh et al. 2018). Physical inactivity has increased among Vietnamese youth, with national surveys reporting sizeable proportions who rarely exercise, and longitudinal data from Ho Chi Minh City documenting adverse trends in activity and sedentary behaviour during adolescence (Ngoc et al. 2020; Trang et al. 2012). These structural changes frame the present study's focus on modifiable lifestyle factors that shape diet quality among university students.

University students represent a pivotal life stage for establishing long-term eating and activity patterns. International evidence shows that diet quality often deteriorates during the transition to adulthood, with higher intakes of discretionary foods and sugar-sweetened beverages and lower intakes of protective foods (Lipsky et al. 2017). Recent data on Vietnamese students indicate suboptimal nutrition profiles and unmet dietary guidance, underscoring the need for targeted prevention in tertiary settings (Thi et al. 2024). Against this

backdrop, understanding the behavioural determinants of diet quality in this population is an immediate public health priority.

Nutrition knowledge is defined as knowledge of concepts and processes related to diet and health, dietary recommendations, and the links between diet and disease (McKinnon et al. 2013). Observational studies consistently report a positive but modest association between nutrition knowledge and healthier dietary patterns. A systematic review synthesised 29 studies and found a significant yet small relationship between knowledge and intake, emphasising measurement quality as a key limitation (Spronk et al. 2014). Large population studies using validated instruments add precision: in the PREDISE study of 1092 adults, each one-point increase in knowledge was associated with a 0.141-point higher Healthy Eating Index score, with stronger effects among individuals with lower education (Carbonneau et al. 2021). These results suggest that knowledge can translate into healthier choices, particularly where educational or socio-economic constraints might otherwise limit diet quality. Among United Kingdom students, strong test scores did not consistently map onto healthier intakes, and among Polish young adults, the association with diet quality was weak or absent, implying that knowledge may be necessary but insufficient when time pressure, cost, convenience, or food access constrain behaviour (Belogianni et al. 2021; Jezewska-Zychowicz and Plichta 2022). This heterogeneity motivates context-specific analysis in Vietnamese students, where campus food environments, cooking skills, and living arrangements may modify the degree to which knowledge influences actual intake.

Physical activity is a second, independent correlate of diet quality. Active young adults typically report higher diet quality scores and lower consumption of discretionary items, consistent with clustering of health behaviours in this age group (Lipsky et al. 2017). In Vietnam, national monitoring and city-based cohorts document low participation in regular activity among youth and rising sedentary time, with implications for weight-related risk and cardio-metabolic health (Ngoc et al. 2020; Trang et al. 2012). Mechanistically, regular activity may reinforce attention to diet composition through performance goals, energy balance monitoring, and heightened self-regulation.

The joint contribution of nutrition knowledge and physical activity to diet quality remains understudied in Vietnam. Prior research has often examined single behaviours, relied on food frequency items not anchored to a validated diet-quality metric, or omitted potential demographic moderators such as sex, age, socio-economic status, and body mass index. Addressing these gaps requires measurement strategies that are brief, population-appropriate, and comparable across settings, and analytic approaches that treat knowledge and activity as continuous predictors rather than categorised exposures.

The present study responds to these needs by assessing Vietnamese university students with validated, widely used instruments. Diet quality is captured by the Diet Quality Questionnaire, a rapid food-group tool that yields indicators aligned with the Global Dietary Recommendations for protective and limit groups and supports cross-country comparability, including in Vietnam (Herforth 2021; Adeyemi et al. 2025). Nutrition knowledge is assessed with a validated general knowledge instrument adapted for consumer relevance in non-professional populations, and physical activity is measured with the International Physical Activity Questionnaire Short Form following established scoring procedures (Parmenter and Wardle 1999; Koch et al. 2021; Puig-Ribera et al. 2015). This design permits estimation of the independent and combined associations of knowledge and activity with diet-quality scores in an urban student cohort and facilitates examination of demographic heterogeneity.

Accordingly, this study has three objectives. First, to describe the distributions of nutrition knowledge, physical activity, and diet quality in Vietnamese university students. Second, to test whether higher knowledge and higher activity are associated with better diet quality after adjustment for key covariates. Third, to examine whether associations differ by sex, age, socio-economic status, or body mass index, given prior evidence of moderation by education and household context in other populations (Carbonneau et al. 2021). By grounding

diet quality in a validated food-group metric and modelling knowledge and activity jointly, the study aims to generate evidence directly relevant to campus-based nutrition education and activity promotion in Vietnam.

2. LITERATURE REVIEW

2.1. Nutritional transition and student diets in Vietnam

Vietnam has experienced rapid economic growth and urbanisation with marked shifts in food environments and daily routines. Analyses of national household data between 2004 and 2014 show widening socio-economic gradients in food choices and nutrient profiles, and a mo e toward convenience and out-of-home eating that tracks urban lifestyles and market expansion (Trinh et al. 2018). Longitudinal evidence from Ho Chi Minh City documents increases in sedentary behaviour and changes in diet during adolescence that elevate cardiometabolic risk, signalling that lifestyle change has been endogenous to the transition rather than an artefact of measurement (Trang et al. 2012). National commentary also points to the rising challenge of diabetes prevention in a context where policy must address behaviours and environments rather than single nutrients (Ngoc et al. 2020). Among university students, recent data indicate mixed nutritional profiles and low adherence to dietary guidance, with underweight persisting alongside emerging overweight and obesogenic practices such as frequent consumption of ultra-processed snacks and sugar-sweetened beverages (Thu Nguyen Thi et al. 2024). Together, these studies position young adults as a priority for prevention because routines adopted during early adulthood can shape lifelong diet quality and activity patterns, a pattern observed in US cohorts that racked diet quality from mid-ado escence into early adulthood (Lipsky et al. 2017).

2.2. Diet quality, nutrition knowledge and physical activity

Diet quality refers to the overall healthfulness of the diet rather than intakes of single nutrients. Two broad approaches are used. One computes indices from detailed intake data such as 24-hour recalls. The other uses food-group tools that capture consumption of protective and limiting foods in ways that reduce respondent burden and social desirability bias. Recovery-biomarker work shows systematic error in self-report methods that complicates energy and nutrient estimation and supports the use of tools that prioritise food patterns over precise quantities when resources are constrained (Freedman et al. 2014). Critiques of food frequency questionnaires underscore recall burden and classification error that can erode validity for surveillance and behavioural analyses (Kristal et al. 2005; Schatzkin et al. 2003). In response, food-group instruments such as the Diet Quality Questionnaire, DQQ, have been developed to provide rapid, comparable indicators of protective foods and foods to limit with minimal portion reporting. The DQQ yields a Food Group Diversity Score, a GDR-Healthy indicator for protective groups, a GDR-Limit indicator for foods to restrict, and an overall Global Dietary Recommendations score. It has been operationalised across more than one hundred countries, including Vietnam, and supports cross-country comparison of food-group exposures relevant to NCD prevention (Herforth 2021; Adeyemi et al. 2025). The combination of brief diet-quality metrics with validated behavioural predictors aligns with the analytic aims of the present study.

Nutrition knowledge is defined as an understanding of diet–health relationships, dietary recommendations, and food composition. It includes declarative knowledge about nutrients and procedural knowledge about how to select foods in practice. The general knowledge questionnaire developed by Parmenter and Wardle provides a foundation for population measurement and has been adapted for diverse settings, while newer consumer-oriented scales distinguish knowledge types and link them to socio-demographic determinants and food choices (Parmenter and Wardle 1999; Koch et al. 2021). A systematic review of twenty-nine studies reported a significant but small association between knowledge and intake, with measurement quality a key source of heterogeneity (Spronk et al. 2014). Large population studies using validated tools have strengthened inference. In the PREDISE study of 1092 adults, each unit increase in nutrition knowledge was associated with a 0.141-point higher Healthy Eating Index score after adjustment. The association was stronger among individuals with lower education, suggesting that knowledge may yield

larger gains where baseline educational resources are constrained (Carbonneau et al. 2021). Results from Luxembourg also link greater nutritional awareness with higher dietary diversity and better adherence to recommendations, independent of socio-economic status, although income attenuated some associations, which points to affordability constraints as a concurrent driver of diet quality (Alkerwi et al. 2015).

Evidence indicates that knowledge interacts with socio-economic position. Knowledge and beliefs can modify the associations between socio-economic status and diet quality, implying both direct and moderating roles for knowledge in shaping intake within resource constraints (Beydoun and Wang 2008). Practical nutrition knowledge also appears to mediate socio-demographic differences in diet quality, which supports the focus on actionable knowledge in consumer settings such as universities (Deroover et al. 2020). Australian community surveys find higher knowledge in women and in those with higher education and income, which aligns with the socio-demographic patterning observed in PREDISE and reinforces the need to adjust for these covariates and to test effect modification by education in analytic models (Hendrie et al. 2008; Carbonneau et al. 2021).

Not all studies find strong translation of knowledge into healthier intake. Among United Kingdom students, high test scores did not consistently predict healthier patterns, indicating that time pressure, price, availability and skills can block behaviour change even when knowledge is adequate (Belogianni et al. 2021). Among Polish young adults, declarative knowledge was associated with avoidance of unhealthy foods but did not robustly increase consumption of healthy foods, which suggests domain-specific links between knowledge and behaviour (Jezewska-Zychowicz and Plichta 2022). In adolescents, research highlights the role of the home environment as a mediator between knowledge and diet quality, a mechanism that can generalise to students living away from home with constrained cooking facilities and limited control over food retail options near campus (Tabbakh and Freeland-Graves 2016). These findings support modelling knowledge as a continuous predictor while recognising that effect sizes are likely to be modest in cross-sectional designs that do not alter environmental constraints.

Physical activity is a second behaviour that is independently correlated with diet quality and often clusters with other healthful practices in young people. US cohort data show that diet quality is tied to lifestyle routines that include fewer sedentary behaviours and less fast-food consumption, while Vietnamese cohorts and national commentary document low participation in regular activity and rising sedentary time among youth. These patterns amplify the health burden associated with poor diets and justify joint analysis of diet quality and activity in students (Lipsky et al. 2017; Trang et al. 2012; Ngoc et al. 2020). For measurement, the International Physical Activity Questionnaire short form provides a standard way to compute total weekly energy expenditure from work, transport and leisure domains and is widely used in epidemiological studies of young adults, including Vietnamese samples, which supports comparability with other contexts (Puig-Ribera et al. 2015).

2.3. Socio-demographic determinants

Gender, age, socio-economic status and body mass index shape knowledge and diet and can modify behaviour–diet associations. Community studies in Australia and elsewhere report higher knowledge among women with greater educational attainment and income, and they identify knowledge as a contributor to socio-economic gradients in food purchasing and diet quality (Hendrie et al. 2008; McKinnon et al. 2013). In student populations, women often report greater engagement with nutrition information during food choice, which is consistent with sex differences in diet beliefs and practices observed in earlier college samples, although such differences are not uniform across settings and may reflect role norms and health salience rather than biological predisposition (Davy et al. 2006). Age patterns are variable. Some evidence suggests modest gains in nutrition knowledge with academic seniority in university samples due to exposure and self-directed learning, while broader population studies show mixed associations between age and knowledge that appear

contingent on educational opportunities and cohort effects rather than age per se (Koch et al. 2021; Chin et al. 2021).

Socio-economic constraints remain decisive. The cost and availability of healthier options shape diet choices even among those with adequate knowledge. Classic work demonstrates that energy-dense diets are cheaper and that low-energy-density diets tend to cost more, which can limit uptake of healthy options in low-income groups and attenuate the benefits of knowledge (Drewnowski and Specter 2004; Darmon et al. 2004). In PREDISE, the knowledge–diet association was stronger among those with lower education, and income attenuated associations between nutritional awareness and diet quality in Luxembourg, which together underscore the importance of testing for moderation by socio-economic markers in student samples where resources and access vary widely (Carbonneau et al. 2021; Alkerwi et al. 2015).

Body mass index often correlates with both knowledge and behaviour, but directionality is inconsistent in cross-sectional analyses. Reviews report that individuals with higher BMI can have lower knowledge, yet some athlete and young adult samples show no linear relationship after adjustment for confounders. These inconsistencies caution against treating BMI as a proxy for knowledge or behaviour and justify its inclusion as a covariate rather than as an outcome in models that target diet quality (Spronk et al. 2014).

This study therefore examines global diet quality as the dependent variable using Diet Quality Questionnaire Global Dietary Recommendations indicators and models general nutrition knowledge and weekly physical activity as continuous predictors with age sex and body mass index as covariates to estimate independent and joint associations that can inform campus education food service changes and activity provision (Uyar et al. 2023). Instruments are selected for validity and feasibility in student surveys with nutrition knowledge captured by a standard general questionnaire and physical activity measured with a short form that yields weekly energy expenditure which aligns measurement with the analytic plan and with behaviours universities can influence through education and activity promotion (Parmenter and Wardle 1999) (Puig-Ribera et al. 2015).

3. METHODOLOGY/MATERIALS

3.1. Study design and participants

This research will employ a cross-sectional design involving 280 university students aged 18–25 years from universities in Hanoi, Ho Chi Minh, and Da Nang city. These are centrally governed city representatives that cover the North, Central, and South of Vietnam. A convenience sampling method was utilized based on accessibility and willingness to participate, consistent with approaches in comparable nutrition knowledge studies among university populations.

All participants provided informed consent to data collection, ensuring voluntary participation, data confidentiality, and adherence to the principles of research ethics.

Anthropometric measurements and BMI

Body weight and height will be self-reported. Height and weight will be measured to the nearest 1 unit (centimetre and kilogram). Body Mass Index (BMI) will be calculated as weight divided by height squared (kg/m^2) and rounded to one decimal place. BMI categories will follow Asian cut-offs: underweight (<18.5 kg/m^2), normal (18.5–22.9 kg/m^2), overweight (23.0–27.4 kg/m^2), and obese (≥27.5 kg/m^2).

Nutrition knowledge

General nutrition knowledge will be assessed using tools that have been widely validated. The General Nutrition Knowledge Questionnaire has been used in many countries and demonstrates strong psychometric properties (Bukenya et al., 2017). To minimise respondent burden, a shorter consumer-oriented nutrition knowledge scale will be adopted (CoNKS). This scale was designed to reflect the way people talk about food

and contains 20 true-or-false statements. Each item tests procedural or declarative nutrition knowledge using familiar food examples. When the scale was applied in Germany, its internal consistency was acceptable (Koch et al., 2021). For the Vietnamese context, several adaptations are needed. The names of foods will be replaced with common local terms so participants can easily recognise them; for example, “mackerel or scad” will substitute for “salmon,” “mung beans” for “lentils,” and “Cheddar or Laughing-Cow cheese” for Swiss cheeses. Statements that asked respondents to rate whole dishes as healthy or unhealthy will be removed because such comparisons ignore the wider diet. They will be replaced with items that ask participants to compare specific nutrient attributes of two foods, such as salt in sausage versus pork roll or fibre in oats versus white rice. During data collection each correct answer will be scored as 1, while incorrect or “don’t know” responses will be scored as 0. Scores will be summed across the 20 items to produce a nutrition knowledge score between 0 and 20 (Koch et al., 2021).

Physical activity assessment

Physical activity was measured with the Vietnamese-translated International Physical Activity Questionnaire-Short Form (IPAQ-SF), a self-report tool validated for Vietnamese adults (Tran et al., 2018; Pham et al., 2013). This instrument captures vigorous and moderate activities, walking, and sitting time over the past seven days. Participants reported the frequency (days) and duration (hours and minutes) of vigorous activities (e.g., running, fast cycling), moderate activities (e.g., brisk walking, carrying ight loads), and walking bouts of at least 10 minutes. Total weekly metabolic equivalent task (MET) minutes were computed by multiplying vigorous minutes by 8.0, moderate by 4.0, and walking by 3.3, per IPAQ guidelines (Puig-Ribera et al., 2015). Activity levels were categorized as low (<600 MET-min/week), moderate (600–2,999 MET-min/week), or high (≥3,000 MET-min/week). Sedentary behavior was assessed via weekday sitting time. The Vietnamese version demonstrates good test-retest reliability (intraclass correlation >0.80) and fair criterion validity against pedometers and activity logs.

Diet quality assessment

Diet quality was evaluated using the Diet Quality Questionnaire (DQQ), a rapid, yes/no-based tool adapted for over 140 countries, including Vietnam, to measure food group consumption (Uyar et al., 2023; Global Diet Quality Project, 2025). The DQQ queries intake of 29 food groups over the previous 24 hours, using sentinel foods tailored to Vietnamese diets (e.g., rice, pho noodles, and bread for starchy staples; mung beans and peanuts for pulses) (Adeyemi et al., 2025). Questions are structured as "Did you eat (or drink) any…?" followed by ≤7 culturally relevant examples, enabling quick administration without quantity recall. Derived indicators include the Food Group Diversity Score (FGDS; 0–1 points for 10 food groups), GDR-Healthy (0– for protective groups), GDR-Limit (for foods to restrict), and overall GDR score (GDR-Healthy – GDR-Limit + 9; range 0–18) (Herforth, 2021). The Vietnamese adaptation has been validated for population-level food group data, showing suitability for estimating diet quality indicators among women (Uyar et al., 2023).

4. RESULTS/FINDINGS

4.1. Descriptive statistics

Table 1 summarizes the demographic information of the study population in terms of BMI categorization. In this sample, the mean age was similar across BMI categories, ranging from 20.5 to 20.8 years. The majority of participants were female (59.6%). Low physical activity was most common among underweight students (82.2%) and least common among obese students (9.7%), whereas moderate physical activity was more frequent in those with normal and overweight BMI. Mean nutrition-knowledge scores were modestly higher in the underweight group and slightly lower among obese participants, although differences were small.

Table 1. Socio-demographic and behavioural characteristics by BMI category (n = 280)

Characteristic	Underweight	Normal	Overweight	Obese	Total
Age (years) mean (SD)	20.8 (2.0)	20.7 (2.0)	20.5 (2.1)	20.5 (2.3)	20.7 (2.0)
Gender: Male	23 (51.1 %)	54 (35.3 %)	22 (43.1 %)	14 (45.2 %)	113 (40.4 %)
Gender: Female	22 (48.9 %)	99 (64.7 %)	29 (56.9 %)	17 (54.8 %)	167 (59.6 %)
Physical activity: Low	37 (82.2 %)	85 (55.6 %)	16 (31.4 %)	3 (9.7 %)	141 (50.4 %)
Physical activity: Moderate	8 (17.8 %)	63 (41.2 %)	33 (64.7 %)	24 (77.4 %)	128 (45.7 %)
Physical activity: High	0 (0.0 %)	5 (3.3 %)	2 (3.9 %)	4 (12.9 %)	11 (3.9 %)
Knowledge score mean (SD)	14.0 (2.9)	13.7 (3.4)	13.4 (3.0)	13.1 (3.4)	13.6 (3.2)

Internal consistency of the adapted nutrition knowledge scale was evaluated using Cronbach's alpha in SPSS. The 20-item scale achieved acceptable reliability (Cronbach's $\alpha = 0.72$). This value indicates moderate cohesion among items, supporting use in the Vietnamese sample. Subdomain analysis revealed procedural knowledge (7 items) with alpha 0.75, nutrient attributes (7 items) with alpha 0.72, and calorie knowledge (6 items) with alpha 0.64. These subdomain alphas suggest varying reliability, with procedural items showing the strongest consistency. Lower calorie domain alpha may stem from cultural differences in energy awareness, as Vietnamese diets emphasize staples over calorie-dense. No items were removed, as deletion improved alpha by less than 0.03.

To summarise nutrition knowledge responses, all items were grouped into three sub-scales following the approach used in recent studies (Koch et al., 2021): seven items assessed procedural knowledge, seven items assessed declarative knowledge on nutrient contents, and six items assessed declarative knowledge on calories (Table 2).

Vietnamese university students displayed mastery of basic diet concepts. On the procedural sub-scale, roughly 86% of responses were correct, suggesting that messages about balanced diets, the need to consume fruit and vegetables, and myths about fats have been communicated. However, knowledge about specific nutrient contents was more variable. Only about 70% of responses were correct, and the standard deviation was higher. Several misconceptions were apparent: one-third of students incorrectly believed mung beans lacked useful nutrients or that processed meats have the same salt content as pork loaf. These gaps reflect traditional dietary patterns in Vietnam, where plant-based proteins such as beans and lentils are often undervalued compared with rice and meat. The weakest domain was calorie knowledge. Fewer than half of the responses were correct. Many students failed to recognise that fat contains more calories per gram than sugar, or that bacon and whipped cream are more energy-dense than lean meats and plain dairy. In a context where fast food, sugary drinks and high-fat snacks are available, lack of calorie awareness could contribute to rising overweight and obesity

Table 2. Descriptive statistic for nutrition knowledge scale, clustered by knowledge domain

Knowledge domain	Items	Mean sub-scale score (range)	Correct answers (%)	Wrong/unknown answers (%)
Procedural knowledge – understanding basic dietary principles and the role of fats, fruit and vegetables. (eg. "Fat is always bad for health.")	7	6.0 ± 1.06 (0–7)	85.5	14.5
Declarative knowledge on nutrient contents – factual knowledge about the nutritional quality of specific foods. Example items: (eg, "Fatty fish such as mackerel or scad contain healthier fats than red meat")	7	4.88 ± 1.54 (0–7)	69.7	30.3
Declarative knowledge on calories – understanding energy values and caloric comparisons between foods. (eg. "Whipped cream contains fewer calories than the same amount of liquid cream.")	6	2.77 ± 1.61 (0–6)	46.1	53.9

The mean FGDS for the sample was 6.1 (median = 6.0), indicating that students consumed about six of the ten diverse food-group clusters on the previous day. Diversity scores ranged from 2 to 10, with a standard deviation of 1.8. The GDR-Healthy sub-score averaged 3.9 protective food groups (SD = 1.9; range 0–9), whereas the GDR-Limit sub-score averaged 6.1 unhealthy food groups (SD = 2.6; range 0–12). These figures reveal that students reported more than one and a half times as many foods to limit as protective foods. Consequently, the overall GDR score averaged 6.76 ± 3.82 out of a possible 18 points, signalling poor adherence to global dietary recommendations and substantial scope for improvement.

Table 3 shows that starchy staples and grains were the backbone of students' diets; participants consumed a mean of 1.54 out of three staples, and about half of all staple responses were positive. Legumes, nuts, and seeds were under-represented: only 27.7% of responses indicated consumption, and the mean sub-scale score was 0.55 ± 0.60, reflecting that most students ate none or only one of the two items. Vegetables were the least consumed protective group; only one in five vegetable items was reported, and the mean sub-scale score was 0.64 ± 0.75. Even when vegetables were eaten, they tended to be limited to a single type rather than a variety of dark-green leafy and vitamin-A-rich vegetables. Fruit intake was better, with a mean of 1.21 items but still below recommendations.

Dairy and eggs were consumed by about half of the respondents. Fluid milk, yogurt, and cheese contributed to a mean sub-scale score of 1.88 ± 1.00. Unprocessed animal proteins (red meat, poultry, and fish) were also widely consumed; the average participant ate about two of the four items, with about 51% of responses indicating consumption. In contrast, processed meats were eaten by nearly two-thirds of participants, illustrating a preference for convenience meats with higher sodium and saturated fat. Students also reported high consumption of processed snacks and sweets (mean = 2.69 items, with 53.7% of responses positive) and sugar-sweetened beverages (40% of responses positive). Fast-food consumption was less common but still substantial (29.6% of responses), indicating that nearly one-third of respondents visited fast-food outlets the previous day.

Table 3. Consumption patterns for the food cluster from the DQQ scale

Diet-quality domain (clusters)	Items (n)	Mean sub-scale score ± SD (range)	Consumed (%)	Not consumed (%)
Starchy staples & grains	3	1.54 ± 0.65 (0–3)	51.2	48.8
Legumes, nuts & seeds	2	0.55 ± 0.60 (0–2)	27.7	72.3
Vegetables (vitamin-A-rich orange, dark-green leafy & other)	3	0.64 ± 0.75 (0–3)	21.2	78.8
Fruits (vitamin-A-rich, citrus & others)	3	1.21 ± 0.82 (0–3)	40.2	59.8
Dairy & eggs (eggs, cheese, yogurt & fluid milk)	4	1.88 ± 1.00 (0–4)	47.0	53.0
Unprocessed animal proteins (ruminant and non-ruminant red meat, poultry, fish/seafood)	4	2.05 ± 1.01 (0–4)	51.2	48.8
Processed meats	1	0.65 ± 0.48 (0–1)	65.0	35.0
Processed snacks & sweets (baked/grain-based sweets, other sweets, packaged salty snacks, instant noodles, deep-fried food)	5	2.69 ± 1.14 (0–5)	53.7	46.3
Sugar-sweetened beverages (sweet tea/coffee/cocoa, fruit juice/drinks, soft drinks)	3	1.20 ± 0.87 (0–3)	40.0	60.0
Fast food	1	0.30 ± 0.46 (0–1)	29.6	70.4

4.2. Correlation analysis

To provide a clearer picture of the relationships among nutrition knowledge, physical activity and diet quality, the sample was stratified by age, sex and BMI category. For each measure, participants were split at the sample median (≥ median vs < median) rather than using qualitative labels. Non-parametric tests were used to compare continuous outcomes across groups, and χ^2 tests compared the distribution of participants above and below the median. Table 4 summarises the results.

Table 4. Median scores and counts above/below the median for nutrition knowledge, physical activity and diet quality by sociodemographic group

Variable	Category	High nutrition knowledge (n/%)	Low nutrition knowledge < median (n/%)	Median MET (min·wk⁻¹)	High physical activity (n/%)	Low physical activity (n/%)	Median diet quality	High diet quality (n/%)	Low diet quality (n/%)
Age	≤ 22 y	117 (51.5%)	110 (48.5%)	655	114 (50.2%)	113 (49.8%)	7	119 (52.4%)	108 (47.6%)
	23–25 y	31 (58.5%)	22 (41.5%)	348	18 (34.0%)	35 (66.0%)	6	19 (35.8%)	34 (64.2%)
		$\chi^2 = 0.58$, P = 0.45		Mann–Whitney U = 7861.0, P = 0.001	$\chi^2 = 5.96$, P = 0.015		Mann–Whitney U = 7231.0, P = 0.022	$\chi^2 = 6.47$, P = 0.011	
Sex	Female	88 (52.7%)	79 (47.3%)	468	69 (41.3%)	98 (58.7%)	6	82 (49.1%)	85 (50.9%)
	Male	60 (53.1%)	53 (46.9%)	914	70 (61.9%)	43 (38.1%)	7	65 (57.5%)	48 (42.5%)
		$\chi^2 = 0.00$, P = 1.00		Mann–Whitney U = 7024.0, P < 0.001	$\chi^2 = 10.03$, P = 0.002		Mann–Whitney U = 8004.0, P = 0.031	$\chi^2 = 1.59$, P = 0.207	
BMI category	Underweight	28 (62.2%)	17 (37.8%)	244	8 (17.8%)	37 (82.2%)	6	19 (42.2%)	26 (57.8%)
	Normal	80 (52.3%)	73 (47.7%)	513	68 (44.4%)	85 (55.6%)	6	74 (48.4%)	79 (51.6%)
	Overweight	25 (49.0%)	26 (51.0%)	958	35 (68.6%)	16 (31.4%)	7	33 (64.7%)	18 (35.3%)
	Obese	15 (48.4%)	16 (51.6%)	1422	28 (90.3%)	3 (9.7%)	10	21 (67.7%)	10 (32.3%)
		$\chi^2 = 2.15$, P = 0.54		H = 65.56, P < 0.001	$\chi^2 = 47.40$, P < 0.001		H = 22.80, P < 0.001	$\chi^2 = 8.89$, P = 0.031	

Values are medians. Participants were divided into high (above-median) and low (below-median) groups for each outcome; percentages are within each row. Non-parametric tests (Mann–Whitney U for two groups, Kruskal–Wallis H for more than two groups) were used to compare medians across categories. Chi-square tests compared the distribution of participants above and below the median.

For nutrition knowledge, the median scores did not differ significantly by age (U = 5407.5, p = 0.25), sex (U = 9500.5, p = 0.92), or BMI category (H = 1.71, p = 0.63). The proportion of participants scoring above the median was consistent across these groups (χ^2 tests all p > 0.45). However, Spearman correlations revealed a significant positive correlation between age and knowledge (p = 0.003), while knowledge showed no significant correlation with BMI (p = 0.24), diet quality (p = 0.18), or physical activity (p = 0.49).

When examining diet quality, median GDR scores were found to be higher in younger students (≤ 22 years) than older students ($H = 7.23$, $p = 0.022$) and tended to be higher in males than females ($U = 8004.0$, $p = 0.031$). Furthermore, diet quality increased across BMI categories ($H = 22.8$, $p < 0.001$). Spearman correlations indicated that diet quality had a strong positive correlation with physical activity ($p < 0.001$) and a moderate correlation with BMI ($p < 0.001$), but only a weak correlation with age ($p = 0.010$) and knowledge ($p = 0.18$).

In terms of physical activity, median MET minutes were higher in males than females ($U = 7024.0$, $p < 0.001$) and increased across BMI categories ($H = 65.6$, $p < 0.001$). Age was negatively correlated with physical activity ($p < 0.001$). Additionally, the distribution of participants above the median differed across age ($\chi^2 = 5.96$,$p = 0.015$), sex ($\chi^2 = 10.03$, $p = 0.002$), and BMI category ($\chi^2 = 47.40$, $p < 0.001$).

4.3. Regression analysis

The significant positive coefficient for physical activity MET-minutes indicates that higher activity levels are associated with better diet quality scores. For every additional MET-minute per week, the GDR score increases by 0.0029 units. This association holds after controlling for age, sex, and knowledge score. The effect size suggests practical relevance in a population where MET-minutes range from 200 to 3000. Students with MET minutes at the higher end could see GDR scores improved by up to 8.7 units compared to those at the lower end. Age also shows a significant positive association. For each additional year, GDR score increases by 0.1284 units. This implies that older students within the 18-25 range tend to have slightly better diet quality. The effect accumulates over the age span. A 25-year-old student might have a GDR score 0.9 units higher than an 18-year-old, all else equal. Knowledge score shows a smaller but significant positive association. Each unit increase in knowledge links to a 0.1102 unit rise in GDR score. This suggests moderate knowledge impacts diet quality. Sex shows no significant association. The lack of difference between males and females aligns with balanced distributions in the sample. Overall model fit is moderate. R-squared of 0.538 means predictors explain over half the variance in GDR scores. A high condition number flags potential multicollinearity. This could arise from correlations among predictors like age and knowledge. Cross-sectional design limits causal interpretation. Associations do not confirm that higher activity causes better diet. Reverse effects or unmeasured confounders like socioeconomic status remain possible. A sample size of 280 provides power for detection. However, urban focus reduces generalisability to rural students.

Table 5. Multiple Linear Regression Predicting GDR Diet Quality Score

Predictor	β (SE)	95% CI	p-value
Constant	6.9845 (1.137)	[4.746, 9.223]	0.000***
Age	0.1284 (0.045)	[0.040, 0.217]	0.005**
Sex (male=1)	-0.0129 (0.178)	[-0.364, 0.338]	0.942
Knowledge score	0.1102 (0.045)	[0.022, 0.198]	0.014*
PA MET-minutes	0.0029 (0.000)	[0.003, 0.003]	0.000***
Note: *p<0.05, **p<0.01, ***p<0.001.			

5. DISCUSSION/CONCLUSION

Our investigation among Vietnamese university students showed that dietary diversity was limited and that many respondents relied heavily on processed foods, sweets, and sugar-sweetened beverages. The dominance of convenience foods can be explained by the rapid urbanisation and globalised food supply in Viet Nam, which has replaced traditional diets rich in vegetables, legumes, and whole grains with energy-dense products

Despite these unhealthy eating practices, students understood basic dietary principles. High scores on procedural questions about the roles of fruits, vegetables, and fats indicate that public health messaging has reached this population. However, many students lacked detailed knowledge of nutrient composition and calorie content and did not recognise the high energy density of fats. This imbalance between general awareness and specific understanding reflects findings from other settings where knowledge varies widely and does not always translate into healthier behaviour (Alkerwi et al., 2015). Studies in Europe found that declarative nutrition knowledge was associated with avoiding unhealthy foods but did not significantly improve healthy food intake (Jezewska-Zychowicz & Plichta, 2022). These results, together with our data, suggest that information alone is insufficient to change eating habits. Behavioural choices are influenced by taste preferences, convenience, cost, and social norms; theoretical models highlight that knowledge interacts with these contextual factors (Alkerwi et al., 2015).

Physical activity, age, and nutrition knowledge were linked to better diets. Students who engaged in more physical activity were more likely to consume protective foods and limit unhealthy items. Age and knowledge were also predictors of diet quality, whereas sex was not. Active individuals may value nutrition to support performance, pay greater attention to energy balance, and be less prone to mindless snacking. Conversely, sedentary lifestyles are associated with exposure to marketing of energy-dense foods and with passive eating habits (Lipsky et al., 2017). Differences by age, sex, and body mass index further illustrate the complexity of these behaviours. Older students had better diet quality and higher activity levels, possibly because academic workloads and employment demands increase with age. Obese students in our sample were often more active than their normal-weight peers, which may reflect attempts to control weight or greater muscle mass, whereas underweight students were the least active. Such patterns underscore that weight status does not necessarily align with healthy behaviours and that multiple lifestyle factors interact.

It is important to recognise that knowledge, age, and activity together translate into behaviour. Behavioral change requires practical skills such as cooking, meal planning and budgeting, as well as supportive environments that make healthy choices easy. Without these skills and support, students may default to convenience foods even when they know the benefits of fruits and legumes. Physical activity may catalyze healthier eating because active individuals monitor their health more closely, pay attention to energy balance and may experience physiological changes that reduce cravings for energy-dense foods. Sedentary lifestyles, by contrast, expose students to food advertising and passive snacking, reinforcing unhealthy choices. Age may enhance these effects as older students gain experience in managing diets alongside responsibilities. Thus, our findings highlight the need for multifaceted interventions that combine education with skill development, environmental modifications and promotion of active lifestyles.

Vietnam is undergoing a nutrition transition with rapid urbanisation and widening socioeconomic gradients in food choice (Trinh et al. 2018; Nguyen and Trevisan, 2020). In our sample students reported frequent intake of refined staples processed meats and sugar sweetened beverages and low intake of fruit, vegetables, and legumes. Overall diet quality was weak. Higher physical activity, older age, and greater nutrition knowledge predicted a higher Global Dietary Recommendations score, GDR, while sex showed no association. These patterns fit evidence that diet and activity cluster in young adults and that nutrition knowledge relates to intake with small magnitude and heterogeneity across subgroups (Lipsky et al. 2017; Spronk et al. 2014; Carbonneau et al. 2021). Universities and vendors in Vietnam should implement procurement and menu standards aligned with GDR and the Vietnamese Healthy Eating Index, VHEI, use pricing that lowers the relative cost of fruit, vegetables, and legumes, remove upsizing prompts for sugary drinks, set healthy default bundles, and limit placement and promotions for energy dense snacks and drinks. Programmes should include credit bearing physical activity in the first year to leverage behaviour clustering in this age group, and monitoring should use the Diet Quality Questionnaire, DQQ, and VHEI each semester to track protective and limit food groups and to audit vendor compliance (Van et al. 2022; Thi et al. 2024).

To the best of our knowledge, this study is the first to examine nutrition knowledge, physical activity and diet quality using the Global Diet Quality Questionnaire and a validated General Nutrition Knowledge Questionnaire among Vietnamese university students. Previous studies in Vietnam have focused on single behaviours or specific nutrients. By integrating these domains and using a food-based diet quality metric aligned with global recommendations, our research offers a comprehensive picture of young adults' health behaviours. Moreover, the clustered descriptive statistics and regression models provide novel evidence that physical activity predicts adherence to dietary recommendations in this population. These insights contribute to the global literature on behavioural correlates of diet quality and underscore the importance of addressing multiple lifestyle factors in interventions.

6. LIMITATIONS AND FUTURE RESEARCH

This study, while pioneering the use of the Diet Quality Questionnaire among Vietnamese university students, is not without limitations inherent to its cross-sectional design. Self-reported data from questionnaires like the IPAQ-SF and adapted General Nutrition Knowledge Questionnaire are susceptible to recall bias and social desirability effects, potentially leading participants to overreport protective food consumption or underestimate processed items, a bias amplified in collectivist cultures like Vietnam where health behaviors may be influenced by familial expectations. Furthermore, the absence of objective measures, such as accelerometers for activity or biomarkers for nutrient intake, may compromise accuracy, echoing challenges in similar Asian studies where subjective reporting underestimated malnutrition risks (Le et al., 2024). A second set of limitations pertains to sampling and contextual factors specific to Vietnam's transitioning economy. The reliance on convenience sampling from urban universities in Hanoi, Ho Chi Minh City, and Da Nang limits representativeness, as rural students often have differential access to nutritious foods due to geographic and economic disparities (Vuong et al., 2023).

To address these limitations, future research should prioritize longitudinal or experimental designs to elucidate causal pathways, incorporating mixed methods approaches with qualitative interviews to explore barriers like cultural influences and resource constraints. Objective assessments, such as wearable devices for physical activity and dietary biomarkers, would mitigate self-report biases, while stratified random sampling across urban-rural divides and ethnic groups could enhance generalizability. Moreover, validating tools through cognitive interviews in diverse Vietnamese contexts and accounting for seasonal effects via multi-timepoint data collection would strengthen future studies, ultimately contributing to evidence-based policies for youth health in transitioning economies.

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