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Adherence to Recommended Food Group Intake and Associated Sociodemographic and Lifestyle Factors Among Undergraduate Students in Birgunj Nepal

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Abstract

Background

Poor diet quality is a modifiable risk factor for noncommunicable diseases, yet evidence on food-group adherence among adults in semi-urban Nepal remains limited. Undergraduate students are a population because independence may shape behaviors. This study examined adherence to the intake of all five Diet Quality Questionnaire (DQQ) food groups and identified associated sociodemographic and lifestyle factors among undergraduate students in Birgunj, Nepal.

Methods

A cross-sectional study was conducted from January to May 2025 among 380 undergraduate students from three colleges in Birgunj, Nepal. Participants completed a questionnaire assessing sociodemographic characteristics, lifestyle behaviors, and dietary intake using the DQQ. Adherence was defined as consumption of all five aggregate food groups: starchy staples, vegetables, fruits, pulses/nuts/seeds, and animal-source foods. Chi-square tests, t-tests, and multivariable logistic regression were used to examine associated factors.

Results

Participants had a mean age of 21.9 years (SD, 1.84), and 59.7% were male. Overall, 168 students (44.2%) achieved complete adherence. Consumption was highest for starchy staples (100.0%), animal-source foods (91.1%), and vegetables (86.3%), and lower for pulses/nuts/seeds (75.5%) and fruits (65.8%). Higher family income, living with family (AOR, 2.23; 95% CI, 1.42–3.49), and moderate physical activity (AOR, 2.95; 95% CI, 1.71–5.08) were associated with greater odds of adherence. Current smoking was associated with lower odds of adherence (AOR, 0.52; 95% CI, 0.30–0.90).

Conclusion

Fewer than half of students consumed all five DQQ aggregate food groups. These findings highlight dietary gaps and social and behavioral factors that may inform student-centered nutrition promotion strategies in Nepal.

Introduction

Unhealthy dietary patterns are a major modifiable risk factor for non-communicable diseases, including cardiovascular disease, diabetes, obesity, and some cancers.(Alamnia et al., 2023) Globally, NCDs caused at least 43 million deaths in 2021, accounting for approximately 75% of non-pandemic-related deaths worldwide.(Ihme, 2020) Major behavioral risk factors for NCDs include unhealthy diet, physical

inactivity, tobacco use, and harmful alcohol use.(Ihme, 2020) Suboptimal diet alone was estimated to contribute to 11 million deaths and 255 million disability-adjusted life-years globally in 2017, with diets low in whole grains, fruits, nuts and seeds, and vegetables among the leading dietary risks.(Afshin et al., 2019) Food-based dietary guidance therefore emphasizes regular consumption of diverse, nutrient-dense foods across major food groups, including starchy staples, vegetables, fruits, pulses/nuts/seeds, and animal-source foods.(Cámara et al., 2021; Herforth et al., 2019)

Diet quality is a growing public health concern in South Asia, where available evidence indicates low consumption of fruits, vegetables, and animal-source foods, along with high intake of snacks, sweet drinks, and fried foods.(Bishwajit, 2015; Jayawardena & Dewasiri, 2023; Prakash et al., 2020; Scott et al., 2025) Recent evidence from rural Bangladesh, India, and Nepal also indicates low overall diet quality among adults, with more than 90% classified as having moderate or high risk of nutrient inadequacy and diet-related NCDs based on Global Diet Quality Score thresholds.(Scott et al., 2025) Dietary patterns in the region also vary by age, gender, and wealth, suggesting that dietary behavior is shaped by both social and environmental factors.(Dominguez et al., 2022; Grzymisławska et al., 2020; Lipoeto et al., 2013; Pingali & Abraham, 2022) In Asian food environments, dietary behaviors are strongly influenced by social, cultural, and economic conditions, with food price and affordability consistently identified as key barriers to healthy diets.(Gaupholm et al., 2023; Gilcharan Singh et al., 2024; Pingali & Abraham, 2022) These issues are particularly relevant in countries undergoing urbanization and nutrition transition, where access to inexpensive convenience foods may increase while affordability of diverse, nutrient-dense foods remains a challenge.(Margolies et al., 2026; Wood et al., 2026)

In Nepal, diet quality remains an important public health concern. National data from the Global Diet Quality Project suggest that only 39% of the Nepali population consumed all five recommended food groups, indicating persistent gaps in food-group diversity.(Global Diet Quality Project, 2026) These gaps are concerning in the context of Nepal's growing NCD burden and changing food environments. Household-level research in Nepal has shown that dietary diversity varies by geography and socioeconomic conditions; poorer and agricultural households tend to have less complex diets, whereas households receiving remittances and those with better road connectivity tend to have more complex and higher-quality diets.(Shively & Evans, 2021) Although starchy staples remain widely consumed, lower consumption of fruits, pulses/nuts/seeds, and other nutrient-dense foods may limit overall dietary diversity and contribute to long-term cardiometabolic risk.

Nepal's changing food environment may further influence dietary behaviors. Recent evidence from Nepali retail stores found that most packaged food products exceeded thresholds for one or more nutrients of concern, including energy, sugar, fat, saturated fat, and sodium.(Sharma et al., 2025) This is concerning because increased availability of inexpensive packaged and convenience foods may displace more nutrient-dense foods such as fruits, vegetables, pulses, nuts, and seeds, particularly among young people with limited time, budgets, and food preparation opportunities. Although Nepal has made substantial progress in nutrition policy and programming, recent policy reviews indicate that existing nutrition policies have historically focused more on undernutrition, with fewer strategies directly

addressing overnutrition and diet-related NCDs.(Adhikari et al., 2023; Wali et al., 2023) This gap underscores the need for evidence on dietary patterns and food-group adherence among young adults.

Young adulthood is a critical period for the development of long-term dietary and lifestyle behaviors. (Almoraie et al., 2025; Winpenny et al., 2018) Undergraduate students often experience increased independence, changing living arrangements, irregular schedules, academic pressure, and greater exposure to convenient and inexpensive foods.(Almoraie et al., 2025; Sogari et al., 2018) These transitions may contribute to meal skipping, inadequate fruit and vegetable intake, reduced dietary diversity, and greater reliance on energy-dense or highly processed foods. (Almoraie et al., 2025; Sogari et al., 2018; Winpenny et al., 2018) Dietary behaviors during this life stage may also cluster with other health-related behaviors, including physical inactivity, tobacco use, alcohol consumption, and inadequate sleep.(Doak et al., 2023; Lawrence et al., 2020)

Although previous studies in Nepal have examined food choice, eating practices, junk food consumption, and selected lifestyle behaviors among students, limited evidence exists on complete adherence across multiple food groups using a standardized tool such as the Diet Quality Questionnaire (DQQ).(Chuwan, 2025; Dahal et al., 2022; Singh et al., 2021) Evidence is particularly limited in semi-urban and cross-border settings such as Birgunj, a commercial city in southern Nepal near the Nepal–India border. (Bhattarai & Conway, 2020) Food availability, affordability, cultural practices, and household living arrangements in this setting may shape students' dietary choices differently than in larger metropolitan areas.(Chuwan, 2025; Dahal et al., 2022) Therefore, this study aimed to assess complete DQQ food-group adherence among undergraduate students in Birgunj, Nepal, and to examine its association with sociodemographic and lifestyle factors. Complete DQQ food-group adherence was defined as reported consumption from all five aggregate food groups: starchy staples, vegetables, fruits, pulses/nuts/seeds, and animal-source foods. This measure reflects food-group diversity rather than serving-size adequacy. (Herforth et al., 2024)

Methods

Study design and setting

A cross-sectional study was conducted from January to May 2025 among undergraduate students enrolled in selected colleges in Birgunj, Parsa district, Nepal. Birgunj is a semi-urban commercial city in southern Nepal located near the Nepal–India border, with a diverse population and a food environment shaped by local, urbanizing, and cross-border dietary practices. The study was conducted in three management and commerce colleges: National Academy Campus, Global Business College, and Birgunj College. These colleges were selected because they enroll undergraduate students from diverse socioeconomic and residential backgrounds within Birgunj and surrounding areas.

Study population and eligibility criteria

The study population included undergraduate students enrolled in bachelor-level programs at the selected colleges. Students were eligible to participate if they were aged 18 years or older, currently enrolled in one of the participating colleges, able to complete the questionnaire in Nepali or English, and willing to provide informed consent. Students were excluded if they reported a known chronic medical condition requiring specific dietary or lifestyle modification, such as diabetes mellitus, cardiovascular disease, or another condition requiring a medically prescribed diet or activity changes, because these conditions could influence usual dietary and lifestyle behaviors.

Sample size and sampling procedure

The minimum required sample size was estimated using the single population proportion formula, assuming a 95% confidence level, 5% margin of error, and an expected adherence prevalence of 40% based on the Global Diet Quality Project estimate for Nepal. This calculation yielded a minimum required sample size of 370 participants. To ensure adequate sample size, 380 undergraduate students were included in the final analytic sample.

A convenience sampling approach was used because student availability varied across colleges and academic years during data collection. Data collection sessions were coordinated with college administrators. Students who were present during scheduled data collection sessions, met the eligibility criteria, and provided informed consent were invited to participate until the required sample size was achieved. Recruitment was conducted across three colleges and included students from different academic years to capture variation in sociodemographic and lifestyle characteristics among undergraduate students in Birgunj.

Data collection and quality assurance

Data were collected using a structured, self-administered electronic questionnaire consisting of three sections: sociodemographic characteristics, lifestyle behaviors, and dietary intake. The questionnaire was prepared in English and Nepali to support participant comprehension. Before the main data collection, the questionnaire was pilot tested among students from a separate college to assess clarity, readability, flow, completion time, and feasibility of electronic administration. Feedback from pilot testing was used to refine wording and improve usability before final administration.

After ethical approval and permission from the participating colleges were obtained, the research team coordinated with college administrators to schedule data collection sessions. Surveys were administered on college premises, primarily in classrooms or auditoriums, using Google Forms. Before beginning the survey, students received an electronic participant information sheet describing the study purpose, eligibility criteria, procedures, voluntary nature of participation, potential risks and benefits, confidentiality protections, and research team contact information. Electronic informed consent was obtained before survey initiation. Students who selected “Agree” proceeded to the questionnaire,

whereas those who selected “Disagree” exited the survey automatically. The survey required approximately 15–20 minutes to complete.

Several procedures were used to support data quality. The principal investigator was present during survey administration to answer procedural questions, minimize non-response, and ensure that students completed the survey independently without influencing their responses. Survey responses were reviewed for completeness, duplicate entries, inconsistent responses, and implausible values. Data were cleaned, coded, and exported for analysis. Unique participant codes were used, and no personally identifiable information was included in the analytic dataset. Cleaned data were stored in password-protected electronic files accessible only to the research team.

Study measures

The primary outcome was complete Diet Quality Questionnaire (DQQ) food-group adherence. Dietary intake was assessed using the Nepal-adapted DQQ, which asked participants whether they had consumed specified foods during the previous day (“yesterday”).(Herforth et al., 2024; Herforth et al., 2025) The questionnaire was prepared in English and Nepali, and its wording and comprehensibility were assessed during pilot testing. Individual food items were grouped into five aggregate food groups: starchy staples; vegetables; fruits; pulses, nuts, and seeds; and animal-source foods. Each aggregate group was coded as consumed when the participant reported consuming at least one corresponding food item. Participants received one point for each food group consumed, resulting in a total score ranging from 0 to 5. Participants who consumed foods from all five groups were categorized as adherent, whereas those who consumed fewer than five groups were categorized as non-adherent (adherent = 5; non-adherent < 5). This measure reflects previous-day food-group coverage rather than portion-size, nutrient, or usual dietary adequacy.(Herforth et al., 2024)

Sociodemographic measures included age (continuous, completed years), gender (male, female), religion (Hindu, Muslim), monthly family income in Nepalese Rupees (NPR 0–24,999; NPR 25,000–49,999; NPR 50,000–74,999; NPR ≥ 75,000), living arrangement (living with family, living without family), academic program (BBS, BBA, other bachelor-level program), and academic year (first, second, third, fourth).

Lifestyle variables included current smoking or tobacco use, alcohol consumption, sleep duration, and physical activity level. Smoking or tobacco use and alcohol consumption were each categorized as yes or no. Sleep duration was categorized as 7–9 hours, 5–6 hours, or < 5 hours per night. Physical activity was assessed using self-reported weekly minutes of moderate and vigorous activity. Total weighted moderate-to-vigorous physical activity minutes were calculated as minutes of moderate activity plus twice the minutes of vigorous activity. Participants were categorized as having low (< 150 minutes/week), moderate (150–299 minutes/week), or vigorous (≥ 300 minutes/week) physical activity.

Statistical analysis

All analyses were conducted using Stata version 15.1. Descriptive statistics were used to summarize participant sociodemographic characteristics, lifestyle behaviors, individual DQQ food-group consumption, and complete DQQ food-group adherence. Continuous variables were summarized using means and standard deviations, and categorical variables were summarized using frequencies and percentages. For variables with missing responses, analyses were conducted using available data, and denominators were reported where applicable.

The primary outcome was complete DQQ food-group adherence, coded as a binary variable. Participants who reported consuming foods from all five DQQ aggregate food groups were coded as adherent, and those who consumed foods from fewer than five groups were coded as non-adherent. Bivariate analyses compared participant characteristics by adherence status using independent-sample t tests for continuous variables and chi-square tests for categorical variables. Variables examined in bivariate analyses included age, gender, religion, monthly family income, living arrangement, academic program, academic year, smoking status, alcohol consumption, sleep duration, and physical activity level.

Logistic regression was used to examine factors associated with complete DQQ food-group adherence. Unadjusted logistic regression models were first used to estimate crude odds ratios and 95% confidence intervals for each sociodemographic and lifestyle factor. A multivariable logistic regression model was then fitted to estimate adjusted associations. The adjusted model included age, gender, monthly family income, living arrangement, smoking status, alcohol consumption, sleep duration, and physical activity level. Results were reported as crude odds ratios and adjusted odds ratios with corresponding 95% confidence intervals and p-values. For categorical variables with more than two levels, the most relevant comparison group was used as the reference category, including the lowest monthly family income group, living without family, no smoking, no alcohol consumption, 7–9 hours of sleep, and low physical activity. Multicollinearity among variables included in the multivariable model was assessed using variance inflation factors; all values were below 5, indicating no evidence of problematic multicollinearity. Statistical significance was assessed using two-sided p-values < 0.05.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee of IIPH Delhi (IRB #EC/NEW/INST/2022/3164), and permission was obtained from the participating colleges before data collection. The study was conducted in accordance with the ethical standards and guidelines of the Institutional Ethics Committee of IIPH Delhi and applicable regulations governing research involving human participants. Participation was voluntary, and all participants provided electronic informed consent before completing the survey. Students were informed that they could decline participation or withdraw at any time without academic penalty or loss of benefits. Confidentiality was maintained by using anonymized study codes, storing data securely, and restricting access to the research team.

Results

Participant characteristics

A total of 380 undergraduate students were included in the analytic sample. The mean age was 21.9 years (SD, 1.84), and 59.7% were male. Most participants identified as Hindu (88.9%). More than one-third reported a monthly family income of NPR 50,000–74,999 (36.3%), and 25.0% reported a monthly family income of NPR ≥ 75,000. More than half lived with family (54.5%). Students were nearly evenly distributed by academic programs, with 50.3% enrolled in BBS and 49.7% enrolled in BBA. The largest proportion of participants were in the second academic year (33.9%), followed by third year (27.1%), first year (23.9%), and fourth year (15.0%) (Table 1).

Table 1
Participant characteristics by complete DQQ food-group adherence

Characteristic	Overall (N = 380)	Adherent (n = 168)	Non-adherent (n = 212)	P value
Age, years, mean (SD)	21.9 (1.84)	22.0 (1.77)	21.9 (1.90)	0.509
Gender				0.259
Male	227 (59.7)	95 (56.5)	132 (62.3)	
Female	153 (40.3)	73 (43.5)	80 (37.7)	
Religion				0.637
Hindu	338 (88.9)	148 (88.1)	190 (89.6)	
Muslim	42 (11.1)	20 (11.9)	22 (10.4)	
Monthly family income				0.003
NPR 0–24,999	42 (11.1)	8 (4.8)	34 (16.0)	
NPR 25,000–49,999	105 (27.6)	44 (26.2)	61 (28.8)	
NPR 50,000–74,999	138 (36.3)	70 (41.7)	68 (32.1)	
NPR > = 75,000	95 (25.0)	46 (27.4)	49 (23.1)	
Living arrangement				0.001
Living without family	173 (45.5)	61 (36.3)	112 (52.8)	
Living with family	207 (54.5)	107 (63.7)	100 (47.2)	
Academic program				0.251
BBS	191 (50.3)	90 (53.6)	101 (47.6)	
BBA	189 (49.7)	78 (46.4)	111 (52.4)	
Academic year				0.519
First	91 (23.9)	42 (25.0)	49 (23.1)	
Second	129 (33.9)	59 (35.1)	70 (33.0)	
Third	103 (27.1)	47 (28.0)	56 (26.4)	
Fourth	57 (15.0)	20 (11.9)	37 (17.5)	
Smoking status				0.004

Note. Values are n (%) unless otherwise indicated. P values were calculated using chi-square tests for categorical variables and independent-sample t tests for continuous variables. NRP: Nepalese Rupee

Characteristic	Overall (N = 380)	Adherent (n = 168)	Non-adherent (n = 212)	P value
No	263 (69.2)	129 (76.8)	134 (63.2)	
Yes	117 (30.8)	39 (23.2)	78 (36.8)	
Alcohol consumption				0.277
No	279 (73.4)	128 (76.2)	151 (71.2)	
Yes	101 (26.6)	40 (23.8)	61 (28.8)	
Sleep duration				0.513
7–9 hours	222 (58.4)	101 (60.1)	121 (57.1)	
5–6 hours	137 (36.1)	56 (33.3)	81 (38.2)	
< 5 hours	21 (5.5)	11 (6.5)	10 (4.7)	
Physical activity level				< 0.001
Low physical activity	100 (26.3)	26 (15.5)	74 (34.9)	
Moderate physical activity	252 (66.3)	127 (75.6)	125 (59.0)	
Vigorous physical activity	28 (7.4)	15 (8.9)	13 (6.1)	

Note. Values are n (%) unless otherwise indicated. P values were calculated using chi-square tests for categorical variables and independent-sample t tests for continuous variables. NRP: Nepalese Rupee

Regarding lifestyle characteristics, 30.8% of participants reported current smoking or tobacco use, and 26.6% reported alcohol consumption. More than half reported sleeping 7–9 hours per night (58.4%). Most students had moderate physical activity (66.3%), followed by low physical activity (26.3%) and vigorous physical activity (7.4%). Additional detailed smoking and alcohol use patterns among users are presented in Supplementary Table 1.

DQQ food-group consumption and complete adherence

Consumption varied across the five DQQ aggregate food groups. All participants reported consuming starchy staples (100.0%). Consumption was also high for animal-source foods (91.1%) and vegetables (86.3%). Lower consumption was observed for pulses, nuts, and seeds (75.5%) and fruits (65.8%) (Table 2). Overall, 168 students (44.2%) achieved complete DQQ food-group adherence, defined as consumption from all five aggregate food groups. The remaining 212 students (55.8%) were classified as non-adherent. Among all participants, 135 (35.5%) consumed four food groups, 57 (15.0%) consumed three food groups, and 20 (5.3%) consumed two food groups (Table 2).

Table 2
Consumption of DQQ aggregate food groups and complete food-group adherence

Measure	n (%)
DQQ aggregate food-group consumption	
Starchy staples	380 (100.0)
Vegetables	328 (86.3)
Fruits	250 (65.8)
Pulses, nuts, and seeds	287 (75.5)
Animal-source foods	346 (91.1)
DQQ adherence score and complete food-group adherence	
Score 2, non-adherent	20 (5.3)
Score 3, non-adherent	57 (15.0)
Score 4, non-adherent	135 (35.5)
Score 5, adherent	168 (44.2)
Non-adherent, score < 5	212 (55.8)
Adherent, score = 5	168 (44.2)

Note. DQQ = Diet Quality Questionnaire. Food-group consumption was defined as reported consumption of at least one relevant item from each aggregate food group. Complete DQQ food-group adherence was defined as consumption from all five aggregate food groups and reflects food-group diversity rather than serving-size adequacy.

Bivariate associations with complete DQQ food-group adherence

In bivariate analyses, complete DQQ food-group adherence differed significantly by monthly family income, living arrangement, smoking status, and physical activity level (Table 1). Students in higher-income categories were more likely to be adherent than those in the lowest income category ($p = 0.003$). Adherence was also higher among students living with family than among those living without family (51.7% vs. 35.3%; $p = 0.001$).

Smoking status was significantly associated with adherence ($p = 0.004$). Students who reported current smoking or tobacco use had a lower prevalence of complete adherence than non-smokers (33.3% vs. 49.0%). Physical activity level was significantly associated with adherence ($p < 0.001$), with complete adherence observed among 26.0% of students with low physical activity, 50.4% of those with moderate physical activity, and 53.6% of those with vigorous physical activity. Age, gender, religion, academic program, academic year, alcohol consumption, and sleep duration were not significantly associated with complete adherence in bivariate analyses (Table 1).

Factors associated with complete DQQ food-group adherence

In the main multivariable logistic regression model, higher monthly family income, living with family, smoking status, and physical activity remained independently associated with complete DQQ food-group adherence (Table 3). Compared with students reporting monthly family income of NPR 0–24,999, students in higher income groups had significantly greater odds of complete adherence: NPR 25,000–49,999 (AOR, 3.89; 95% CI, 1.55–9.79), NPR 50,000–74,999 (AOR, 4.85; 95% CI, 1.98–11.89), and NPR ≥ 75,000 (AOR, 5.10; 95% CI, 1.98–13.11). Students living with family had more than twice the odds of complete adherence compared with those living without family (AOR, 2.23; 95% CI, 1.42–3.49). Current smoking or tobacco use was associated with lower odds of complete adherence (AOR, 0.52; 95% CI, 0.30–0.90). Compared with students with low physical activity, those with moderate physical activity had significantly greater odds of complete adherence (AOR, 2.95; 95% CI, 1.71–5.08). Students with vigorous physical activity also had greater odds of adherence, although the association was not statistically significant (AOR, 2.39; 95% CI, 0.96–5.96). Age, gender, alcohol consumption, and sleep duration were not significantly associated with complete DQQ food-group adherence in the adjusted model (Table 3). Multicollinearity diagnostics indicated no evidence of problematic collinearity in the full model, with all variance inflation factors below 5.

Table 3
Factors associated with complete DQQ food-group adherence

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)	Adjusted P value
Age, years	1.04 (0.93–1.16)	1.07 (0.95–1.21)	0.254
Gender			
Male	Reference	Reference	
Female	1.27 (0.84–1.92)	1.14 (0.73–1.79)	0.568
Monthly family income			
NPR 0–24,999	Reference	Reference	
NPR 25,000–49,999	3.07 (1.29–7.26)	3.89 (1.55–9.79)	0.004
NPR 50,000–74,999	4.38 (1.89–10.13)	4.85 (1.98–11.89)	< 0.001
NPR > = 75,000	3.99 (1.67–9.51)	5.10 (1.98–13.11)	< 0.001
Living arrangement			
Living without family	Reference	Reference	
Living with family	1.96 (1.30–2.97)	2.23 (1.42–3.49)	< 0.001
Smoking status			
No	Reference	Reference	
Yes	0.52 (0.33–0.82)	0.52 (0.30–0.90)	0.019
Alcohol consumption			
No	Reference	Reference	
Yes	0.77 (0.49–1.23)	1.17 (0.66–2.09)	0.595
Sleep duration			
7–9 hours	Reference	Reference	
5–6 hours	0.83 (0.54–1.27)	0.83 (0.52–1.34)	0.449
< 5 hours	1.32 (0.54–3.23)	1.50 (0.57–3.95)	0.409
Physical activity level			
Low physical activity	Reference	Reference	

Note. OR = odds ratio; CI = confidence interval; DQQ = Diet Quality Questionnaire. The adjusted model included age, gender, monthly family income, living arrangement, smoking status, alcohol consumption, sleep duration, and physical activity level.

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)	Adjusted P value
Moderate physical activity	2.89 (1.74–4.82)	2.95 (1.71–5.08)	< 0.001
Vigorous physical activity	3.28 (1.38–7.81)	2.39 (0.96–5.96)	0.062

Note. OR = odds ratio; CI = confidence interval; DQQ = Diet Quality Questionnaire. The adjusted model included age, gender, monthly family income, living arrangement, smoking status, alcohol consumption, sleep duration, and physical activity level.

Discussion

In this cross-sectional study of undergraduate students in Birgunj, Nepal, less than half adhered to all five DQQ food groups. Consumption was universal for starchy staples and relatively high for animal-source foods and vegetables, whereas fruits and pulses, nuts, and seeds were less commonly consumed. Higher monthly family income, living with family, and moderate physical activity were independently associated with greater odds of complete DQQ food-group adherence. In contrast, current smoking or tobacco use was associated with lower odds of adherence. These findings extend the limited evidence on dietary behaviors among undergraduate students in Nepal by examining positive food-group coverage using a standardized dietary assessment framework rather than focusing exclusively on junk-food consumption, meal skipping, or nutrition knowledge.

The prevalence of complete DQQ food-group adherence in the present study was modestly higher than the national estimate of 39% reported by the Global Diet Quality Project for Nepal.(Global Diet Quality Project, 2026) However, this comparison should be interpreted cautiously because the national estimate was derived from a broader population with greater heterogeneity in age, geographic location, and socioeconomic circumstances, whereas the present study included undergraduate students attending three colleges in Birgunj. The relatively higher prevalence among students may reflect greater access to diverse foods in a commercial and cross-border city, the socioeconomic profile of college students, or differences in household living arrangements.(Dubey & Maddhesia, 2019; Paudel et al., 2018) Nevertheless, fewer than half of the students met the study definition of complete DQQ food-group adherence, indicating that important gaps in food-group coverage remain among college-attending young adults in this setting.

The food-group pattern observed in Birgunj was broadly consistent with evidence from Nepal and other South Asian settings showing that diets are commonly centered on starchy staples while fruits, legumes, nuts, seeds, and other nutrient-dense foods are consumed less consistently.(Scott et al., 2025; Shively & Evans, 2021) In the present sample, approximately one-third of students did not consume fruit and approximately one-quarter did not consume pulses, nuts, or seeds, despite relatively high consumption of vegetables and animal-source foods. These gaps are nutritionally relevant because fruits and pulses, nuts, and seeds contribute dietary fiber, micronutrients, plant-based protein, and unsaturated fats.(Nolden & Forde, 2023) The findings therefore suggest that incomplete adherence was driven primarily

by inconsistent consumption of selected nutrient-dense food groups rather than by insufficient coverage of staple foods.

The present findings complement previous studies of university students in Kathmandu that documented suboptimal eating behaviors using measures distinct from DQQ. Pokharel and Dhungel found that most information-technology undergraduates had poor eating habits and inadequate nutrition knowledge, with meal skipping particularly breakfast skipping being common. Convenience, taste, and irregular college schedules were identified as important influences on eating behavior.(Pokharel & Dhungel, 2023) Similarly, Pokhrel and colleagues found that 83.5% of university students consumed junk food, although only 6% identified it as their preferred food, suggesting that social and environmental influences, including peer pressure, may shape dietary behavior independently of stated preferences. (Pokhrel et al., 2024) Another study also reported frequent junk-food consumption among undergraduates and identified accessibility, convenience, and immediate availability as important correlates.(Chuwan, 2025) Although these studies assessed junk-food consumption, meal skipping, preferences, and nutrition knowledge rather than complete DQQ adherence, they describe complementary dimensions of dietary behavior among Nepalese university students. Complete DQQ adherence does not necessarily indicate an entirely healthy diet because students may also consume packaged snacks, sugar-sweetened beverages, fried foods, or other foods recommended for limitation. Future studies should assess both recommended food-group consumption and less healthful food intake to provide a more comprehensive evaluation of student diet quality.

Monthly family income was one of the strongest correlates of complete DQQ food-group adherence. Compared with students in the lowest-income category, those in each higher-income category had approximately four to five times greater adjusted odds of consuming all five food groups, suggesting that household economic resources may facilitate access to a more diverse diet. Evidence from Nepalese university students, however, indicates that greater financial resources do not necessarily translate exclusively into healthier food choices. Pokharel and Dhungel found that monthly pocket money was associated with greater expenditure on fast food and junk food among information-technology undergraduates in Kathmandu.(Pokharel & Dhungel, 2023) Although pocket money and household income represent distinct socioeconomic measures, these findings suggest that greater purchasing capacity may increase access to both nutrient-dense foods and less healthful convenience foods. The relationship between economic resources and dietary behavior may therefore depend on the affordability, availability, and appeal of foods within and around college environments. The magnitude of the income associations in the present study should also be interpreted cautiously because the lowest-income reference group included only 42 students, resulting in relatively wide confidence intervals.

Living with family was independently associated with more than twice the odds of complete food-group adherence. This finding is consistent with the Kathmandu study by Dahal and colleagues, in which students' current living status was associated with their food choices and eating practices.(Dahal et al., 2022) Students living with family may have greater access to shared household food resources, home-prepared meals, and more regular eating routines, whereas those living away from family may face

limited cooking facilities, tighter food budgets, irregular schedules, and greater reliance on foods purchased outside the home.(Almoraie et al., 2025) However, these mechanisms were not measured directly, and living arrangement should therefore be interpreted as a marker of the broader household and food environment rather than as a direct cause of dietary adherence.

Current smoking or tobacco use was associated with 48% lower adjusted odds of complete DQQ adherence. This finding is consistent with evidence that modifiable health-risk behaviors may cluster among Nepalese university students. Shakya and colleagues assessed smoking, alcohol use, physical activity, and fruit and vegetable consumption among medical students in Kathmandu and identified clustering of these NCD risk factors.(Shakya et al., 2015) Similarly, a study of college students in Pokhara documented the concurrent presence of smoking, tobacco use, and widespread junk-food consumption, although associations between tobacco use and dietary behavior were not directly examined.(Shrestha, 2022) Although these studies did not directly evaluate tobacco use as an independent correlate of food-group adherence, they provide contextual support for the coexistence of tobacco use and suboptimal dietary practices. The association observed in the present study may reflect shared determinants, including peer norms, academic stress, irregular routines, or lower engagement in health-promoting behaviors. Because these factors were not measured and the study was cross-sectional, temporality and causality cannot be established.

Moderate physical activity was associated with nearly three times the adjusted odds of complete DQQ adherence compared with low physical activity. This association may reflect clustering of health-promoting behaviors, whereby students who are physically active may also be more likely to engage in healthier dietary practices. Previous studies among Nepalese university and health-professions students have documented the concurrent presence of dietary and physical-activity risk factors, although they did not examine physical activity as a predictor of complete food-group adherence.(Nepal et al., 2024; Shakya et al., 2015) The present study therefore adds evidence of an independent association between moderate physical activity and complete adherence. However, vigorous physical activity was not statistically significantly associated with adherence after adjustment. Only 28 students were classified as having vigorous physical activity, resulting in limited statistical precision. The findings therefore do not demonstrate a dose–response relationship between increasing physical activity and food-group adherence.

Age and gender were not independently associated with complete DQQ food-group adherence. The absence of a gender association is consistent with Chuwan's finding that the frequency of junk-food consumption did not differ significantly by sex.(Chuwan, 2025) However, it contrasts with Pokhrel and colleagues, who observed bivariate associations between sex and junk-food consumption,(Pokhrel et al., 2024) and with Dahal and colleagues, who identified some gender differences in food-choice motives and eating practices.(Dahal et al., 2022) These differences may reflect variation in outcomes: complete food-group coverage, junk-food consumption, food preferences, and eating practices represent related but distinct aspects of dietary behavior.

Academic programs and academic year were also not associated with adherence in the present study. Chuwan similarly found that academic faculty was not a significant predictor of junk-food consumption frequency,(Chuwan, 2025) whereas Pokhrel and colleagues reported a bivariate association between subject specialization and junk-food consumption.(Pokhrel et al., 2024) Because the present sample included only BBS and BBA students, limited variation in academic disciplines may have reduced the ability to detect program-related differences. Studies including students from a broader range of academic fields may provide a more informative assessment of whether academic context influences dietary behavior.

Alcohol consumption and sleep duration were not independently associated with complete DQQ food-group adherence. This contrasts with Nepalese university studies linking alcohol and tobacco use with poorer sleep outcomes, although those studies did not directly examine dietary adherence.(Bogati et al., 2020; Nepal et al., 2024) Differences in outcomes and measurement may explain the inconsistent findings, as the present study used broad categories of alcohol use and sleep duration. More detailed measures may be needed to clarify their relationships with dietary behavior.

Strengths and limitations

This study has several strengths. It addresses an important evidence gap by examining food-group adherence among undergraduate students in Birgunj, an understudied semi-urban setting in Nepal. The inclusion of students from three colleges and different academic years increased variation in socioeconomic, residential, and lifestyle characteristics. Dietary intake was assessed using the Diet Quality Questionnaire, providing a standardized framework for evaluating consumption across five aggregate food groups. The analysis also considered multiple sociodemographic and behavioral factors simultaneously, allowing identification of independent correlates of complete food-group adherence. In addition, the study clearly distinguished complete DQQ food-group adherence from serving-size or nutrient adequacy, supporting appropriate interpretation of the outcome.

Several limitations should be considered. The cross-sectional design precludes conclusions regarding temporality or causality, and convenience sampling from management and commerce colleges in one city may limit generalizability and introduce selection bias. Dietary intake and lifestyle behaviors were self-reported and may be affected by recall error, social-desirability bias, or misclassification. The DQQ does not assess portion sizes, nutrient intake, total energy intake, or usual dietary patterns; therefore, complete adherence reflects food-group coverage rather than quantitative dietary adequacy. The binary outcome may also obscure variation within the non-adherent group. In addition, unmeasured factors, including food insecurity, nutrition knowledge, food prices, meal skipping, academic stress, peer influences, cooking facilities, and campus food availability, may contribute to residual confounding. Small numbers in the lowest-income and vigorous physical activity groups also reduced the precision of selected estimates.

Public health implications

The findings suggest that student nutrition programs in Birgunj should prioritize affordable access to fruits, pulses, nuts, and seeds. Colleges could integrate nutrition education into wellness programming, improve the availability of healthy cafeteria options, and provide targeted support for students living away from family and those from lower-income households. Given the observed associations of dietary adherence with smoking and physical activity, integrated programs addressing nutrition, tobacco prevention or cessation, and physical activity should be evaluated among undergraduate students.

Conclusion

Among undergraduate students in Birgunj, Nepal, less than half adhered to all five DQQ food groups. Adherence was particularly low for fruits and pulses/nuts/seeds. Higher family income, living with family, non-smoking status, and moderate physical activity were associated with better dietary adherence. These findings support the need for targeted, college-based nutrition and lifestyle interventions that address socioeconomic barriers, living arrangements, and clustering of health behaviors among young adults.

Declarations

Conflicts of Interest/Competing Interests

The authors declare that they have no competing interests.

Ethical Approval and accordance

Ethical approval was obtained from the Institutional Ethics Committee of IIPH Delhi (IRB #EC/NEW/INST/2022/3164). The study was conducted in accordance with the ethical standards and guidelines of the Institutional Ethics Committee of IIPH Delhi and applicable regulations governing research involving human participants.

Consent to Participate

Electronic informed consent was obtained from all participants before their participation in the study.

Consent for Publication

Not applicable.

Clinical Trial

Not applicable.

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Author Contribution

Conceptualization, A.C.; methodology, A.C.; formal analysis, A.C.; investigation, A.C.; data curation, A.C.; writing—original draft preparation, A.C.; writing—review and editing, A.C., P.C., and G.K.; supervision, P.C. and G.K.; project administration, A.C. All authors read and approved the final manuscript.

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Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Code Availability

Not applicable. No custom software or code was developed for this study.

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