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Consumption of ultra-processed foods among female students from health colleges

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Abstract

Earlier studies have shown an association between consuming ultra-processed foods (UPFs) and impaired health. The present work thus aimed to assess the consumption of UPFs by health college students using the NOVA Food Classification System. A cross-sectional study (*n* = 180) was conducted among female Saudi students in the health colleges (aged 20.53 ± 1.11 years). A self-reported questionnaire was used to validate the Food Frequency Questionnaire, and distributed online. Mean ± standard deviation or frequency (percentages) were reported, and linear trend was examined for the association between UPFs consumption and nutrient intake. UPFs contributed to 47.62 ± 16.53% of the total intake, followed by unprocessed or minimally processed foods (UFs), which contributed to 40.25 ± 17.04%. In the adjusted models, as UPF intake increased, the intake of carbohydrates, saturated fatty acids, and added sugars increased, while the intake of proteins, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, omega-3, and omega-6 decreased ($p < 0.05$). In conclusion, most student diets were composed of UPFs, followed by UFs. High UPF consumption was linked to lower diet quality, as evidenced by an unhealthy nutrient profile. Health education programs are needed to raise awareness about the health risks associated with high UPF consumption.

Introduction

Food intake and dietary habits have shifted towards consuming meals outside the home, at restaurants, and incorporating highly processed foods (Washi and Ageib, 2010; Delavari *et al*., 2013). In recent decades, dietary intake has been characterised by high consumption of high-energy-dense foods and low consumption of fruits and vegetables (Delavari *et al*., 2013). Previous studies have shown a decrease in the intake of fruits, vegetables, and milk, whereas the consumption of processed foods has increased (Al-Otaibi and Basuny, 2015). This has led to an increased consumption of carbohydrates, cholesterols, and fats in the Saudi Arabian population (Washi and Ageib, 2010; Alsubaie, 2018).

Epidemiological studies have consistently demonstrated associations between ultra-processed foods (UPFs) consumption and an elevated risk of obesity, type 2 diabetes, cardiovascular disease, and certain cancers (Chen *et al*., 2020). These foods often displace nutrient-dense dietary options, contributing to micronutrient deficiencies and poor overall dietary quality. Moreover, UPFs are thought to disrupt metabolic health through multiple biological pathways, including changes in gut microbiota, chronic low-grade inflammation, insulin resistance, and increased glycaemic load. Recent evidence also suggests potential links between UPFs and mental health conditions, such as depression and anxiety, although these mechanisms remain under investigation (Chen *et al*., 2020; Fajkic *et al*., 2025).

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The cumulative and often subtle effects of chronic UPF consumption underscore its role as a major public health concern in the modern diet.

Several studies have reported poor dietary intake among university students (Moreno-Gomez *et al*., 2012; Bernardo *et al*., 2017; Stroebele-Benschop *et al*., 2018; Alothman *et al*., 2024). Studies have revealed unhealthy lifestyle patterns among university students. However, data on the dietary intake of university students in Arab countries are limited. University students are at a critical life stage where lifelong dietary habits are often established, making it a key period for nutrition-related interventions. This population is particularly vulnerable to poor dietary patterns owing to academic stress, time constraints, limited cooking skills, financial limitations, and increased exposure to fast foods and UPFs. Therefore, the objective of the present work was to assess UPF consumption using the NOVA Food Classification System among health college students. The present work hypothesised that UPF consumption among health college students would be high.

Materials and methods

Study design

This cross-sectional study was conducted on health college students in Riyadh. Female Saudi students (aged 18 and 26 years old) were involved. Students with dietary restrictions due to health conditions, such as celiac disease and food allergies, and/or those following a vegetarian/vegan diet, and pregnant women, were excluded. Students in their internship years were also excluded. Ethical approval was obtained from the Institutional Review Board (IRB) (IRB no.: 21-009). Consent was obtained from all participants prior to completing the questionnaire.

Research instrument

A self-reported questionnaire was distributed online in Arabic and consisted of two sections. The sociodemographic section included information such as age, marital status, state of residence, and field of study. The second section was the Food Frequency Questionnaire (FFQ), which was used to assess dietary intake. The FFQ is a validated European Prospective Investigation of Cancer Food frequency questionnaire, adapted and translated to Arabic by Gosadi *et al*. (2017). Macronutrient and micronutrient intakes were analysed using ESHA's Food Processor (version 11.7.1). Participants with missing dietary information and those with an implausible energy intake of less than 500 kcal or more than 3500 kcal per day were excluded from the analysis (Michels *et al*., 2000; Salmeron *et al*., 2001; Schulze *et al*., 2004; Fung *et al*., 2009; Turner-McGrievy *et al*., 2014; Rhee *et al*., 2015).

NOVA Food Classification System

FFQ was analysed to measure UPF consumption using the NOVA Food Classification System. NOVA is a tool that classifies foods into four categories based on processing on a scale of one to four, from the least to the most processed (Monteiro *et al*., 2019; Aljahdali *et al*., 2024). Food categories in the NOVA system include "unprocessed" or "minimally processed foods" (UFs), which are edible plant or animal components that have been obtained directly from nature or have undergone very little modification or preservation. "Processed culinary ingredients" (PCIs) come from unprocessed or minimally processed foods and include items such as sugar, starch, salt, and oil. "Processed foods" (PFs) are created by combining UF and PCIs foods, including canned vegetables, cured meats, and freshly baked breads. "Ultra-processed foods" (UPFs) comprise ready-to-eat industrially prepared meals made mainly or completely from substances derived from foods and additives, with little if any intact UF (Monteiro *et al*., 2019). Ultra-processed foods were also expressed as a percentage of total energy intake.

Statistical analysis

Descriptive statistics were presented as mean ± standard deviation (SD) or frequency (percentages) for continuous and categorical variables, respectively. We examined the association between UPF consumption and diet quality assessed *via* nutrient intake by examining the linear trend of the total mean nutrient content across the tertials of UPFs. The tertials of UPFs was modelled as ordinal variable to get the *p*-value for the linear trend. We expressed the nutrients of interest as kilocalories (kcal) or μg/mg/g/IU per 1,000 kcal. As an attempt to reduce the chance of misclassifying food items listed in the FFQ into one of the NOVA groups, the authors proposed another classification and considered sensitivity analysis. Sensitivity classification for NOVA gave same conclusions as the primary NOVA classification, so the main classification was only presented. Tests were two-sided and the significance level was set for 0.05. Statistical Analysis Systems (SAS) software (SAS Institute Inc., Cary, NC) version 9.4 was used for all analyses.

Results

The analysis included 180 students from medical female campus. Table 1 shows the descriptive statistics of the analytical sample. The average age was 20.53 ± 1.11 years old, ranged from 18 - 24 years old, with 96% of the sample were single, and 97% were living with their families. Students from the Health and Rehabilitation Science were the highest contributors to the study sample, followed by Nursing (31%), Dentistry (21%), and Pharmacy (8%).

Table 2 shows the average dietary shared from each of the four NOVA groups. UPFs contribute a mean of 47.62 ± 16.53% from the total energy intake, followed by unprocessed or minimally processed foods, which contribute a mean of 40.25 ± 17.04% of the total energy intakes.

Table 1. Sociodemographic characteristics of study population (*n* = 180).

	N (%) or mean ± SD
Age (years)	20.53 ± 1.11
Marital status	
Married	7 (3.89)
Single	173 (96.11)
Residence	
With family	175 (97.22)
Student residence	5 (2.78)
Major	
Nursing	55 (30.56)
Pharmacy	15 (8.33)
Dentistry	38 (21.11)
Health and Rehabilitation Science	72 (40.00)
Year (missing 3 observations)	
1^{st}	49 (27.22)
2^{nd}	53 (29.44)
3^{rd}	51 (28.33)
4^{th}	23 (12.78)
5^{th}	1 (0.56)

Table 2. Mean dietary caloric contribution of NOVA groups within study population (*n* = 180).

	Mean of % of total energy intake ± SD
Unprocessed or minimally processed foods (UFs)	40.25 ± 17.04
Processed culinary ingredients (PCIs)	0.46 ± 0.59
Processed foods (PFs)	11.67 ± 8.37
Ultra-processed foods (UPFs)	47.62 ± 16.53

Tables 3 and 4 show the total average nutrient intake across the UPF tertiles. Mean energy intake of the sample was 1498.78 ± 736.86 kcal per day, while UPF consumption, expressed as a percentage of total energy intake, was 29 ± 8 (min. 11, max. 41) for the 1^{st} tertile, 48 ± 4 (min. 41, max. 55) for the 2^{nd} tertile, and 66 ± 9 (min. 55, max. 86) for the 3^{rd} tertile. In adjusted models, as the UPF intake increased, the intake of carbohydrates, saturated fatty acids, added sugars, iron, calcium, vitamin B_1, and vitamin E increased, while the intake of protein, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, magnesium, phosphorous, potassium, vitamin D, zinc, copper, vitamin A, carotene, retinol, vitamin B_2, vitamin B_3, vitamin B_{12}, biotin, vitamin C, vitamin K_1, pantothenic acid, fluoride, omega-3, and omega-6 decreased (p-values < 0.05).

Table 3. Macronutrients profile according to caloric contribution of ultra-processed foods within study population (n = 180).

	Total intake	UPFs (% of total energy intake)			*p*-value for trend	
		Tertile 1	**Tertile 2**	**Tertile 3**		
	Mean ± SD	**29.35 ± 7.93**	**47.87 ± 4.48**	**65.62 ± 8.75**	**Crude**	**Adjusted***
		***n* = 60**	***n* = 60**	***n* = 60**		
Total energy intake (kcal)	1499 ± 737	1512 ±735	1416 ± 698	1569 ± 779	0.6717	0.5889
Calories from carbohydrates (kcal)	747.0 ± 413.6	683.6 ± 430.2	717.4 ± 362.5	840.1 ± 434.3	0.0378	0.0308
Carbohydrates (% of TEE)	49.69 ± 8.59	44.93 ± 10.94	50.84 ± 6.36	53.31 ± 5.13	< 0.0001	< 0.0001
Calories from protein (kcal)	285.6 ± 172.1	360.3 ± 211.6	260.4 ± 133.4	236.1 ± 135.8	< 0.0001	0.0001
Protein (% of TEE)	19.16 ± 5.89	23.83 ± 6.48	18.48 ± 3.47	15.18 ± 3.54	< 0.0001	< 0.0001
Calories from fat (kcal)	468.3 ± 236.7	480.2 ± 231.9	439.8 ± 234.7	484.9 ± 244.8	0.9120	0.8072
Fat (% of TEE)	31.17 ± 5.22	31.73 ± 5.15	30.64 ± 4.56	31.14 ± 5.90	0.5387	0.6732
Calories from SAT (kcal)	158.1 ± 87.9	146.9 ± 65.7	147.9 ± 91.0	179.4 ± 100.7	0.0420	0.0376
SAT (% of TEE)	10.55 ± 2.85	9.89 ± 2.03	10.21 ± 2.66	11.55 ± 3.45	0.0013	0.0013
Calories from TRANS (kcal)	1.41 ± 2.0	1.2 ± 1.2	1.9 ± 2.9	1.2 ± 1.5	0.8455	0.7060
TRANS (% of TEE)	0.09 ± 0.1	0.08 ± 0.06	0.12 ± 0.13	0.07 ± 0.08	0.7431	0.6140
Calories from MUFA (kcal)	139.2 ± 73.0	151.24 ±79.43	132.93 ± 72.28	133.41 ± 66.25	0.1814	0.2689
MUFA (% of TEE)	9.31 ± 2.19	10.0 ± 2.3	9.3 ± 2.0	8.6 ± 2.0	0.0003	0.0007
Calories from PUFA (kcal)	82.8 ± 46.9	89.9 ± 54.5	78.7 ± 40.7	79.9 ± 44.3	0.2460	0.3448
PUFA (% of TEE)	5.47 ± 1.26	5.82 ± 1.58	5.54 ± 1.03	5.06 ± 0.97	0.0009	0.0018
Fibers (g/1000 kcal)	13.62 ± 4.41	13.5 ± 5.45	13.65 ± 3.54	13.73 ± 4.08	0.7788	0.8236
Added sugars (g/1000 kcal)	11.92 ± 10.19	6.08 ± 4.46	12.71 ± 7.49	16.98 ± 13.32	< 0.0001	< 0.0001
Total sugars (g/1000 kcal)	43.14 ± 18.56	42.36 ± 22.7	43.1 ± 16.44	43.96 ± 16.08	0.6392	0.7955
Cholesterol (mg/1000 kcal)	165.97 ± 81.47	205.45 ± 91.35	156.96 ± 63.23	135.51 ± 71.99	< 0.0001	< 0.0001
Omega-3 (g/1000 kcal)	0.54 ± 0.16	0.62 ± 0.2	0.53 ± 0.13	0.47 ± 0.11	< 0.0001	< 0.0001
Omega-6 (g/1000 kcal)	5.1 ± 1.28	5.47 ± 1.56	5.17 ± 1.13	4.67 ± 0.97	0.0005	0.0012

UPFs: ultra-processed foods; kcal: kilocalories; SAT: saturated fatty acids; TRANS: trans fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; mg: milligram; and g: gram. Values are mean ± standard deviation (SD). (*): linear regression models were adjusted for age.

Table 4. Micronutrients profile according to caloric contribution of the ultra-processed foods in the study population (n = 180).

	Total intake	UPFs (% of total energy intake)			p-value for trend	
	Mean ± SD	Tertile 1 29.35 ± 7.93 n = 60	Tertile 2 47.87 ± 4.48 n = 60	Tertile 3 65.62 ± 8.75 n = 60	Crude	Adjusted*
Sodium (mg/1000 kcal)	1379 ± 295	1415 ± 319	1409 ± 243	1313 ± 310	0.0592	0.0744
Iron (mg/1000 kcal)	8.77 ± 2.36	8.36 ± 1.79	8.65 ± 1.43	9.31 ± 3.35	0.0264	0.0247
Calcium (mg/1000 kcal)	595 ± 245	501± 218	588 ± 233	697 ± 245	< 0.0001	< 0.0001
Magnesium (mg/1000 kcal)	130.5 ± 37.9	148.3 ± 46.1	133.0 ± 26.9	110.3 ± 27.6	< 0.0001	< 0.0001
Phosphorous (mg/1000 kcal)	571 ± 146	658 ± 171	580 ± 96	474 ± 94	< 0.0001	< 0.0001
Potassium (mg/1000 kcal)	1292 ± 438	1555 ± 534	1286 ± 299	1035 ± 263	< 0.0001	< 0.0001
Vitamin D (IU/1000 kcal)	74.78 ± 53.14	88.47 ± 67.96	72.63 ± 43.54	63.26 ± 41.51	0.0090	0.0132
Zinc (mg/1000 kcal)	4.59 ± 1.48	5.66 ± 1.81	4.43 ± 0.86	3.67 ± 0.75	< 0.0001	< 0.0001
Copper (mg/1000 kcal)	0.92 ± 0.8	1.3 ± 1.06	0.92 ± 0.68	0.54 ± 0.2	< 0.0001	< 0.0001
Manganese (mg/1000 kcal)	1.03 ± 0.55	0.95 ± 0.51	1.06 ± 0.45	1.07 ± 0.68	0.2598	0.2355
Selenium (µg/1000 kcal)	49.68 ± 16.88	56.18 ± 19.2	50.22 ± 13.54	42.64 ± 14.79	< 0.0001	< 0.0001
Vitamin A (RAE/1000 kcal)	603.1 ± 592.1	921.6 ± 751.9	594.0 ± 476.1	293.8 ± 266.4	< 0.0001	< 0.0001
Vitamin B_1 (mg/1000 kcal)	0.75 ± 0.19	0.7 ± 0.15	0.77 ± 0.13	0.8 ± 0.25	0.0041	0.0041
Vitamin B_2 (mg/1000 kcal)	1.02 ± 0.31	1.14 ± 0.39	1.01 ± 0.21	0.92 ± 0.27	< 0.0001	< 0.0001
Vitamin B_3 - NE (mg/1000 kcal)	14.13 ± 4.91	16.92 ± 5.69	14.07 ± 3.79	11.4 ± 3.31	< 0.0001	< 0.0001
Vitamin B_6 (mg/1000 kcal)	0.9 ± 0.25	1.01 ± 0.27	0.88 ± 0.15	0.82 ± 0.29	< 0.0001	< 0.0001
Vitamin B_{12} (µg/1000 kcal)	3.99 ± 4.18	5.83 ± 5.77	3.79 ± 3.35	2.35 ± 1.52	< 0.0001	< 0.0001
Folates - DFE (µg/1000 kcal)	256.62 ± 67.29	266.24 ± 75.3	259.03 ± 63.7	244.58 ± 61.34	0.0778	0.1000
Biotin (µg/1000 kcal)	4.67 ± 3.09	4.87 ± 3.19	4.7 ± 2.88	4.45 ± 3.23	0.4686	0.6975
Vitamin C (mg/1000 kcal)	43.09 ± 30.7	54.81 ± 40.35	42.12 ± 26.63	32.35 ± 16.26	< 0.0001	< 0.0001
Vitamin E (mg/1000 kcal)	4.28 ± 1.6	4.1 ± 1.48	3.98 ± 1.23	4.76 ± 1.92	0.0216	0.0228
Vitamin K_1 (µg/1000 kcal)	78.82 ± 71.07	106.07 ±87.04	81.28 ± 69.77	49.13 ± 34.99	< 0.0001	< 0.0001
Caffeine (mg/1000 kcal)	70.16 ± 82.17	75.95 ±110.72	67.81 ± 66.8	66.73 ± 60.94	0.5402	0.4008
Pantothenic acid (mg/1000 kcal)	1.41 ± 0.64	1.73 ± 0.86	1.35 ± 0.44	1.17 ± 0.37	< 0.0001	< 0.0001
Chromium (µg/1000 kcal)	1.2 ± 0.95	0.97 ± 0.71	1.31 ± 0.88	1.31 ± 1.18	0.0532	0.0350
Fluoride (mg/1000 kcal)	0.3 ± 0.33	0.38 ± 0.44	0.3 ± 0.27	0.23 ± 0.25	0.0152	0.0131
Iodine (µg/1000 kcal)	9.77 ± 8.44	9.54 ± 8.29	10.27 ± 7.96	9.49 ± 9.15	0.9763	0.8045

UPFs: ultra-processed foods; mg: milligram; µg: microgram; and IU: international unit. Values are mean ± standard deviation.
(*): linear regression models were adjusted for age.

Discussion

The present work assessed the consumption of UPF by health college students using the NOVA Food Classification System. The study found that the majority of student diets were composed of UPFs (48%), followed by UFs (40%). High UPF consumption was associated with a high intake of carbohydrates, saturated fatty acids, added sugars, iron, calcium, vitamin B_1, and vitamin E, and a low intake of protein, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, omega-3, omega-6, magnesium, phosphorous, potassium, vitamin D, zinc, copper, vitamin A, carotene, retinol, vitamin B_2, vitamin B_3, vitamin B_{12}, biotin, vitamin C, vitamin K_1, pantothenic acid, and fluoride.

It was reported earlier that UPF consumption among young adults varied between 40 - 50% of total energy intake (Bielemann *et al*., 2015; Mescoloto *et al*., 2017; Machado *et al*., 2020). A study conducted in Australia found that UPFs contributed to 38.9% of the total kcal intake in young adults (Machado *et al*., 2020). Another study reported that UPF consumption corresponded to 51.2% of total energy intake among adults aged ≥ 20 years old in Brazil (Bielemann *et al*., 2015). We found that UPF consumption was higher among women and individuals with higher educational levels (Bielemann *et al*., 2015). According to the study findings, the mean energy intake was approximately 1500 kcal, whereas UPFs accounted for approximately 48% of the daily calorie intake of healthcare students. These findings are consistent with those of previous studies documenting the elevated use of highly processed foods among university students (Al-Qahtani, 2016; Mescoloto *et al*., 2017; Alzahrani *et al*., 2020). A study conducted among university students in Brazil found the mean kcal intake was 1800 kcal, with 42.19% from UFs, 9.71% from processed foods, and 41.01% from UPFs. Another study in India found that almost 39% of medical students preferred fried snacks over unprocessed snacks such as vegetables (Vibhute *et al*., 2018).

Few studies have assessed the consumption of UPFs using the NOVA classification among young individuals, especially in Arab countries. Several studies have measured the consumption of UPFs *via* self-reported eating habits or patterns related to the consumption of specific food items, such as French fries or soft drinks, which may lead to overestimation of UPF consumption (Musaiger and Kalam, 2014; Al-Qahtani, 2016; Alzahrani *et al*., 2020). A cross-sectional study was conducted among medical students (1 - 6 years) at the College of Medicine, University of Dammam, Saudi Arabia, which found that almost 91% of the students were consuming fast foods (Al-Qahtani, 2016). A recent study measured the eating habits of medical students in Jeddah, Saudi Arabia (Alzahrani *et al*., 2020). The study found that about 66% of the students went to fast-food restaurants "sometimes," followed by 28% of students eating fast food "often" (Alzahrani *et al*., 2020). The study concluded that unhealthy dietary habits among medical students included inadequate consumption of fruits and vegetables, as well as frequent consumption of fried and fast foods (Alzahrani *et al*., 2020). Another study in Syria found that only 14% of adolescents have reported fast food consumption more than four times per week (Musaiger and Kalam, 2014).

Evidence has shown an association between UPFs and non-communicable chronic diseases. This is concerning as they may have a detrimental effect on nutrient intake and play a role in the development of obesity (Martinez Steele *et al*., 2016; Morales *et al*., 2023). In addition, it is associated with metabolic syndromes and non-communicable diseases (Tavares *et al*., 2012; Canella *et al*., 2014). Ultra-processed foods frequently lack essential nutrients and fibres, and are heavy in added sugar, salt, and unhealthy fats (Vandevijvere *et al*., 2013). A high intake of processed foods may displace nutrient-dense, minimally processed food choices, leading to an overall decline in diet quality related to adverse health outcomes (Vandevijvere *et al*., 2013; Martinez Steele *et al*., 2016; Morales *et al*., 2023; Lane *et al*., 2024). A meta-analysis reported that high UPF was associated with an increased risk of adverse health outcomes, especially cardiometabolic disorders, common mental disorders, and mortality (Lane *et al*., 2024). Due to the lack of essential nutrients, such as fibre, vitamin D, and antioxidants, UPFs are increasingly recognised as factors associated with metabolic and hormonal disorders, including cancer, *via* several interrelated mechanisms, including alterations to the gut microbiome, epigenetic modifications, persistent low-grade inflammation, and endocrine interference (Fajkic *et al*., 2025). In addition, it has been linked to higher UPF consumption and lower bone mineral density associated with increased risk of osteoporosis and osteopenia (Brooks *et al*., 2025; Ciaffi *et al*., 2025).

Reduced bone density is associated with lower levels of vitamins D, calcium, and vitamin K (Abrams and O'Brien, 2004; Cockayne *et al*., 2006).

A previous study found that students from health colleges had higher nutrition knowledge scores than those from humanities colleges (Alzaben *et al*., 2021). Another study of the same population found that the average nutritional score was 20 out of 36 using HPLP-II. The HPLP II assesses six subscales of lifestyle behaviours: health responsibility, spiritual growth, physical activity, interpersonal relationships, nutrition, and stress management (Alothman *et al*., 2024). This study found that the total HPLP II score was lower in students from health science colleges than in those from science colleges. Both studies observed that, although nutrition knowledge was high among students from health science colleges, nutrition and life practices were low (Alzaben *et al*., 2021; Alothman *et al*., 2024). These findings highlighted the need for targeted interventions to promote healthier dietary practices and reduce the reliance on highly processed food products among university students in Saudi Arabia. Effective strategies may include nutrition education campaigns; improved availability and accessibility of minimally processed foods on campus; and policy initiatives that encourage the production and consumption of whole, unprocessed, or minimally processed food items.

Saudi Arabia has taken major steps toward promoting public health by developing national dietary guidelines aimed at improving nutritional behaviour and reducing processed and UPF consumption (Alhumaidan, 2025). In response to the increasing rates of obesity, diabetes, and other non-communicable diseases, the Saudi Ministry of Health, in collaboration with the Saudi Food and Drug Authority and other stakeholders, has prioritised the formulation of evidence-based dietary recommendations. These guidelines emphasise the importance of whole foods such as fruits, vegetables, whole grains, and lean proteins, while discouraging the excessive intake of foods high in added sugars, saturated fats, and sodium, which are commonly found in processed products (Alzaben *et al*., 2021; SFDA, 2025; Dunford *et al*., 2025). Our incentives, educational campaigns, front-of-pack labelling, and regulatory measures targeting food manufacturers further reflect the country's commitment to reshaping the food environment and encouraging healthier consumer choice products (Alzaben *et al*., 2021; Alhumaidan, 2025; SFDA, 2025; Dunford *et al*., 2025). By aligning its dietary policies with global best practices, Saudi Arabia aims to mitigate the health burden associated with poor diet quality and to support the long-term well-being of its population.

Nevertheless, the present work was not without limitations. First, we acknowledge that the present work may be underpowered owing to its small sample size; however, the purpose of this preliminary descriptive study was to provide insights into UPFs consumption. Given the small sample size, we could not proceed with a stratified analysis; therefore, further studies with a large sample size are needed to evaluate the sociodemographic characteristics associated with UPFs combinations. Second, the use of FFQ in the present work has both strengths and weaknesses. While FFQ may lead to food intake misreporting, it effectively captures usual food intake (Vijay *et al*., 2020). Assessing usual food intake may capture the overall diet quality among populations by considering seasonal differences in food intake (Fowke *et al*., 2004). FFQ has been validated for dietary intake in the Saudi population (Gosadi *et al*., 2017); however, it has not been validated for NOVA calculations due to the lack of information about cooking methods and brand names that may be crucial for accurately classifying food items within the NOVA classification system (Aljahdali *et al*., 2024). Finally, it would be worthwhile to assess the association between UPFs and sociodemographic and lifestyle factors; however, not all sociodemographic information was collected owing to the length of the FFQ and concerns about participants not completing the survey.

The diet of university students was high in UPFs, which was associated with a high intake of carbohydrates, saturated fatty acids, and added sugars, and a low intake of protein, monounsaturated fatty acids, and polyunsaturated fatty acids. However, further studies are needed to assess the factors and health outcomes associated with high UPF consumption. The results of the present work offer valuable insights into the eating habits of students from a healthcare perspective. These findings highlight the importance of practicing efficacious nutrition-focused interventions to encourage the adoption of more nutrient-dense and minimally processed food choices, thereby promoting general health and well-being. A comprehensive and multilevel strategy involving policy-level regulation, community-based education, and individual behavioural changes is recommended to reduce the intake of processed and UPFs. Future interventions should prioritise nutrition education campaigns targeting schools, workplaces, and communities to raise awareness of the health risks associated with processed food consumption. Additionally, reformulating processed products to reduce added sugars, sodium, and unhealthy fats while promoting the availability and affordability of whole, minimally processed foods is essential. Collaboration between food manufacturers, healthcare providers, and media platforms can amplify these efforts. Investing in longitudinal research to monitor dietary patterns and evaluate the effectiveness of these interventions is critical to ensure sustainable dietary improvements and reduce the burden of diet-related chronic diseases.

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