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AN AUTHOR-DEVELOPED NOVA-UPF FREQUENCY MODULE FOR ASSESSING ULTRA-PROCESSED FOOD CONSUMPTION IN ADULTS: A PILOT STUDY

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Abstract. *Ultra-processed food intake is difficult to assess using conventional dietary tools because similar food groups may include homemade, artisanal and industrially formulated products. This pilot cross-sectional study examined the feasibility, internal consistency and preliminary performance of an author-developed NOVA-UPF frequency module adapted to common regional food products and dietary habits. An anonymous online questionnaire was completed by 200 adults. The module included 15 ultra-processed food categories, scored from 0 to 6 according to reported frequency of consumption, producing a preliminary UPF frequency score with a theoretical range of 0–90. The sample was predominantly female (69.0%), younger than 45 years (72.5%) and urban (65.0%); BMI ≥25 kg/m² was present in 59.0%, while at least one analysed metabolic disorder was reported by 41.5% of participants. The observed UPF score ranged from 0 to 60, with a mean of 20.84 ± 12.75, median 19 and interquartile range 11–26. Internal consistency was high (Cronbach's α = 0.882). Corrected item-total correlations exceeded 0.30 for 14 of 15 items, ranging from 0.361 to 0.679; only protein bars, "fit" sweets and meal replacements showed a lower value (r = 0.277), while alpha if item deleted ranged from 0.868 to 0.884. The most frequently consumed categories at least once weekly were industrial sweets (62.0%), industrial sauces and dressings (53.0%), salty snacks (52.5%), industrial biscuits/wafers (52.5%), processed meat products (48.0%), industrial cakes and sweet pastries (47.5%) and sugar-sweetened beverages (46.0%). The UPF score was higher in men than women (median 24.0 vs. 17.5; p = 0.002) and decreased with age (ρ = −0.325; p < 0.001), but was not significantly associated with BMI category or education. The module appears feasible for rapid screening and ranking of UPF consumption frequency, but requires validation against 24-hour recalls or dietary records before use as an intake estimation tool.*

Keywords: *ultra-processed food, NOVA classification, dietary assessment, frequency score, pilot study*

Introduction

Ultra-processed foods represent a distinct category within the NOVA food classification system, which groups foods according to the extent and purpose of industrial processing rather than only by nutrient composition or traditional food groups. These products are typically formulated from refined ingredients, additives and industrial components, with little or no intact whole foods, and commonly include sugar-sweetened beverages, packaged snacks, confectionery, processed meat products, instant foods and ready-to-eat meals [1].

The increasing intake of ultra-processed foods has become a relevant public-health concern. Recent umbrella reviews have linked higher UPF exposure with an increased risk of several adverse outcomes, particularly cardiometabolic disorders, obesity-related outcomes, common mental disorders and all-cause mortality [2,3]. However, accurate assessment of UPF intake remains methodologically demanding. Conventional dietary tools often classify foods by type, but do not always distinguish homemade, artisanal and industrially formulated versions of similar products. This is especially important for foods such as bread, pastries, desserts, processed meats, sauces and ready meals, where the degree of processing may vary substantially.

Several NOVA-based FFQs and short screeners have been developed to address this limitation. Longer instruments can provide more detailed intake estimates, while brief frequency modules may be more feasible for online surveys and population screening. Still, such tools require cultural and market-specific adaptation, since UPF categories depend on locally available products, common eating habits and the way respondents understand food examples [4-6].

In the regional context, there is a need for a simple instrument that can identify frequent consumption of locally relevant UPF categories without the burden of detailed dietary assessment. Therefore, this pilot study aimed to examine the feasibility, internal consistency and preliminary performance of an author-developed NOVA-UPF frequency module adapted to common regional food products and dietary habits in adults.

Methodology

This pilot cross-sectional study was conducted using an anonymous Google Forms questionnaire in 200 adults who confirmed informed consent. The questionnaire included basic sociodemographic data, selected health-related variables and an author-developed NOVA-UPF frequency module.

Sociodemographic variables included sex, age group, place of residence, education level and smoking status. Health-related variables included BMI category and self-reported physician-diagnosed type 2 diabetes, prediabetes, hypertension and dyslipidaemia.

The author-developed module included 15 ultra-processed food categories selected according to the NOVA classification and adapted to common regional food products and dietary habits. For each category, participants reported usual consumption frequency using seven response options, ranging from "never or less than once monthly" to "two or more times daily". Responses were scored from 0 to 6, and the sum of all 15 items formed a preliminary UPF frequency score with a theoretical range from 0 to 90. The score was used as an indicator of relative frequency of UPF consumption, not as an estimate of grams, portions or energy share. Since the module had not been validated against a reference dietary method, all findings were interpreted as exploratory.

Statistical analysis

Statistical analysis was performed using Python 3.11. Categorical variables were presented as frequencies and percentages. The preliminary UPF frequency score was described using mean, standard deviation, median, interquartile range, minimum and maximum values.

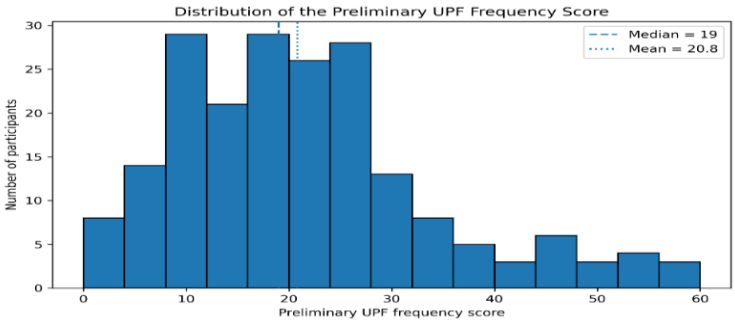
For each UPF category, weekly and more frequent consumption were calculated. Internal consistency of the 15-item module was assessed using Cronbach's alpha, corrected item-total correlations and Cronbach's alpha if item deleted. Non-parametric tests were used: Mann-Whitney U test for sex-based differences, Kruskal-Wallis test for age group, BMI category and education level, and Spearman's rank correlation for ordinal associations. Statistical significance was set at $p < 0.05$.

Results

A total of 200 adult participants were included in the analysis. The sample was predominantly female (69.0%), younger than 45 years (72.5%) and urban (65.0%). Most participants had completed college/university education (39.5%) or secondary school (36.0%), while 24.0% had postgraduate-level education. BMI ≥25 kg/m² was present in 59.0% of respondents. Hypertension and dyslipidaemia were each reported by 26.0% of participants, prediabetes by 9.5%, and type 2 diabetes by 2.5%. At least one analysed metabolic disorder was present in 41.5% of the sample.

The preliminary UPF frequency score had a theoretical range of 0–90. In this sample, the observed range was 0–60, with a mean score of 20.84 ± 12.75, median 19 and interquartile range 11–26. The distribution of the preliminary UPF frequency score is shown in Figure 1.

Figure 1. Distribution of the preliminary ultra-processed food (UPF) frequency score in the study sample.



Internal consistency of the author-developed 15-item UPF frequency module was high (Cronbach's $\alpha = 0.882$). Corrected item-total correlations were above 0.30 for 14 of 15 items, ranging from 0.361 to 0.679. The only item below this threshold was protein bars, "fit" sweets and meal replacements ($r = 0.277$). Cronbach's alpha if item deleted ranged from 0.868 to 0.884, indicating that removal of any single item would not meaningfully improve internal consistency.

The most frequently reported UPF categories consumed at least once weekly were industrial sweets (62.0%), industrial sauces and dressings (53.0%), salty snacks (52.5%), industrial biscuits, wafers and filled cookies (52.5%), processed meat products (48.0%), industrial cakes and sweet pastries (47.5%), and sugar-sweetened and carbonated beverages (46.0%). Daily or more frequent consumption was most often reported for sugar-sweetened and carbonated beverages (14.5%) and industrial sweets (11.0%). The least frequently reported weekly categories were ready-made and semi-ready meals (14.0%), energy drinks (16.0%), and sweetened breakfast cereals or granola (17.0%).

Table 1. Frequency of ultra-processed food category consumption

UPF category	≥1 time weekly n (%)	≥2–4 times weekly n (%)
Industrial sweets	124 (62.0)	92 (46.0)
Industrial sauces and dressings	106 (53.0)	76 (38.0)
Salty snacks	105 (52.5)	69 (34.5)
Industrial biscuits, wafers and filled cookies	105 (52.5)	72 (36.0)
Processed meat products	96 (48.0)	62 (31.0)
Industrial cakes and sweet pastries	95 (47.5)	65 (32.5)
Sugar-sweetened and carbonated beverages	92 (46.0)	70 (35.0)
Fast food meals	71 (35.5)	40 (20.0)
Industrial fruit juices, nectars and sweetened beverages	60 (30.0)	36 (18.0)
Sweetened dairy products and desserts	55 (27.5)	30 (15.0)
Protein bars, "fit" sweets and meal replacements	43 (21.5)	21 (10.5)
Instant products	42 (21.0)	21 (10.5)

Sweetened breakfast cereals and granola	34 (17.0)	23 (11.5)
Energy drinks	32 (16.0)	22 (11.0)
Ready-made and semi-ready meals	28 (14.0)	15 (7.5)

The preliminary UPF frequency score was significantly higher in men than in women (median 24.0 vs. 17.5; Mann-Whitney $U = 3064.0$; $p = 0.002$). Age group showed a significant negative association with the UPF score (Spearman $\rho = -0.325$; $p < 0.001$), with the highest scores among participants younger than 45 years and the lowest scores among those older than 64 years. No statistically significant association was observed between UPF score and BMI category (Kruskal-Wallis $p = 0.459$; Spearman $\rho = 0.085$; $p = 0.233$). Education level was also not significantly associated with the UPF score (Kruskal-Wallis $p = 0.269$; Spearman $\rho = -0.087$; $p = 0.222$).

Discussion

The findings of this pilot study are consistent with the current direction of UPF assessment research, which increasingly favours short, context-adapted instruments for rapid screening. The author-developed 15-item module showed high internal consistency (Cronbach's $\alpha = 0.882$), which is methodologically encouraging when compared with existing short HPF/UPF tools. Martinez-Perez et al. developed the sQ-HPF as a short screening questionnaire based on 14 food groups associated with high highly processed food consumption in the PREDIMED-Plus cohort. Their approach also relied on frequency-based reporting and aimed to capture an overall HPF dietary pattern rather than precise intake in grams or energy percentage [7]. In that sense, the present module follows a similar practical logic, but remains at an earlier stage because it has not yet been validated against a dietary reference method.

The need for local adaptation is also supported by validation studies of the Nova-UPF screener. In Portuguese adults, the adapted Nova-UPF screener included 25 subgroups and showed strong agreement with UPF contribution to total energy intake, with PABAK = 0.86 [5]. In Senegal, adaptation of the same conceptual tool required expert review and restructuring of categories according to the local food environment; validation against 24-hour recall showed near-perfect agreement, with PABAK = 0.84 [6]. These findings support the central premise of the present study: a regional UPF module should not be a literal translation of an existing questionnaire, but should include locally recognisable products and categories.

The category pattern observed in this sample also corresponds with broader European data. In adults across 22 European countries, the energy share from ultra-processed foods varied from 14% to 44%, with fine bakery wares and soft drinks frequently ranked among the main contributors [8]. In the present study, industrial sweets were consumed at least once weekly by 62.0% of participants, followed by industrial sauces and dressings (53.0%), salty snacks (52.5%), industrial biscuits/wafers (52.5%), processed meat products (48.0%), industrial cakes and sweet pastries (47.5%) and sugar-sweetened beverages (46.0%). Although our module measured

frequency rather than energy contribution, the dominance of sweet industrial products, bakery-type foods and sweetened beverages is broadly compatible with the European pattern described by Mertens et al.

Sociodemographic differences in this pilot sample also partly align with previous evidence. The preliminary UPF frequency score was higher in men and decreased significantly with age, while no significant association was observed with BMI category or education level. A systematic review of nationally representative samples reported that UPF intake differs across several sociodemographic variables, with younger age and urbanisation often associated with higher intake, while education and socioeconomic status show less consistent patterns across countries (Dicken et al., 2024). This supports cautious interpretation of the present findings: the observed age gradient is in line with previous literature, whereas the lack of association with education may reflect sample structure, limited statistical power or country-specific dietary patterns rather than absence of a true relationship.

Overall, these comparisons suggest that the author-developed module has a plausible structure and captures categories relevant to both regional food habits and broader European UPF patterns. However, internal consistency and expected subgroup differences do not establish criterion validity. The next methodological step should be validation against 24-hour recalls, multi-day dietary records or another reference dietary assessment method, along with test-retest reliability assessment in a larger and more balanced sample.

The author-developed UPF frequency module showed high internal consistency in this pilot sample (Cronbach's $\alpha = 0.882$). Cronbach's alpha is a measure of internal consistency, but it should not be interpreted as evidence of criterion validity [10]. Corrected item-total correlations were above 0.30 for 14 of 15 items, while only protein bars, "fit" sweets and meal replacements had a lower value ($r = 0.277$). Since removal of this item would only minimally increase alpha from 0.882 to 0.884, there was no clear statistical reason to exclude it at this stage. This category may represent a more specific UPF subgroup related to fitness-oriented or weight-control products and should be further examined in future validation. Item-level analysis is particularly useful in early instrument development because it identifies items that may require refinement before formal validation [11].

In the present pilot sample, the most frequently consumed UPF categories at least once weekly were industrial sweets (62.0%), industrial sauces and dressings (53.0%), salty snacks (52.5%), industrial biscuits, wafers and filled cookies (52.5%), processed meat products (48.0%), industrial cakes and sweet pastries (47.5%) and sugar-sweetened beverages (46.0%). Although this study assessed frequency rather than energy contribution, this pattern is broadly consistent with European data. In adults across 22 European countries, ultra-processed foods contributed approximately 14–44% of total energy intake, with fine bakery wares and soft drinks frequently identified among the main contributors [8]. Similar product groups were also central

in the sQ-HPF, where highly processed food consumption was captured through a short list of 14 food categories derived from a longer FFQ [7].

The high frequency of sweets, biscuits/wafers, sweet pastries, salty snacks and sugar-sweetened beverages in this pilot sample therefore supports the inclusion of these items as core categories in a regional UPF frequency module. Processed meat products and industrial sauces also appeared frequently in our sample, which is relevant for the regional dietary context, where cured meats, pâtés, sausages, mayonnaise-based products and commercial sauces are widely available and easily recognised by respondents.

The preliminary UPF frequency score was higher in men and decreased significantly with age. This age-related finding is consistent with a systematic review of nationally representative studies, which reported higher UPF intake among younger adults and substantial variation by sociodemographic factors, including age, urbanisation, income, education and region [9]. The absence of a significant association with education in the present study should be interpreted cautiously, since previous studies show inconsistent education-related patterns across countries. In the US NHANES analysis, for example, UPF intake differed by age, sex, income and education, but the direction and magnitude of associations varied across subgroups [12].

Overall, our findings suggest that the author-developed module captures product categories that are both locally recognisable and comparable with dominant UPF patterns reported in European and international studies. However, the score remains a frequency-based pilot measure and should be validated against 24-hour recalls or dietary records before being used as an estimate of actual UPF energy contribution.

The present module follows the same methodological direction as recent short UPF and HPF assessment tools: it reduces respondent burden and aims to rank individuals according to the frequency of consuming key ultra-processed food categories. The sQ-HPF was developed as a 14-item short screening questionnaire derived from a longer FFQ and designed to capture a highly processed food dietary pattern rather than exact intake in grams or energy percentage [7]. Similarly, the original Brazilian Nova score showed that the dietary share of ultra-processed foods increased linearly across higher score categories, supporting the use of simplified scores for ranking UPF exposure [13]. Our 15-item module follows this frequency-based logic, but remains at an earlier stage because it has not yet been validated against a dietary reference method.

Recent validation studies show that short screeners can perform well when they are locally adapted and compared with 24-hour recall data. The Portuguese Nova-UPF screener included 25 subgroups and showed strong agreement with UPF energy contribution, with PABAK = 0.86 [5]. The Senegalese adaptation required expert review, local food-market data and restructuring of categories, achieving PABAK = 0.84 against 24-hour recall [6]. The Ecuadorian NOVA 27 screener identified 27 locally relevant UPF subgroups covering approximately 90% of UPF-derived energy

intake and showed high agreement across most sociodemographic groups, with PABAK values above 0.8 [14]. These studies indicate that the validity of a short UPF screener depends not only on its length, but also on the relevance of selected categories, clarity of examples and comparison with a reference dietary method.

The Korean simplified NOVA-based tool is particularly close to the concept of the present module. It selected 10 food groups contributing at least 80% of UPF-derived energy intake, converted intake frequency into a 0–50 score and was explicitly presented as a preliminary tool requiring further refinement and validation [15]. This supports the interpretation of our 0–90 UPF frequency score as a pilot ranking measure, not as a direct estimate of UPF energy share. The next methodological step should include test-retest reliability and criterion validation against one or more 24-hour recalls or multi-day dietary records. Only after this stage could the score be evaluated as a proxy indicator of actual UPF intake, rather than a measure of reported frequency alone.

Limitations and future directions

This study has several limitations. The sample was recruited online and was not representative of the general adult population, with women, younger adults and urban participants overrepresented. All data were self-reported, including BMI category, health-related variables and food consumption frequency, which may introduce recall and reporting bias.

The author-developed NOVA-UPF module measures frequency of consumption, not portion size, grams or percentage of total energy from ultra-processed foods. It also does not capture brand names, ingredient lists or preparation method, which may affect classification of borderline products.

Although the module showed high internal consistency in this pilot sample, it has not yet been validated against a reference dietary assessment method. Therefore, the preliminary UPF frequency score should be interpreted as an exploratory ranking measure. Future studies should include larger and more balanced samples, test-retest reliability, and validation against repeated 24-hour recalls or multi-day dietary records. Items with weaker performance, particularly protein bars, “fit” sweets and meal replacements, should be further refined before wider use.

Conclusion

The author-developed NOVA-UPF frequency module showed good feasibility and strong internal consistency in this pilot adult sample. The preliminary score captured a clear range of reported UPF consumption frequency, with the highest weekly intake observed for industrial sweets, sauces and dressings, salty snacks, industrial biscuits and wafers, processed meat products, sweet pastries and sugar-sweetened beverages. These categories appear relevant for regional dietary screening and align with dominant UPF patterns reported in European and international studies.

The score was higher in men and decreased with age, while no significant association was observed with BMI category or education level. These findings suggest that the module can detect meaningful variation in UPF consumption frequency across population subgroups, but they do not establish validity. The instrument should therefore be interpreted as a preliminary ranking tool, not as a measure of grams, portions or UPF-derived energy intake.

Overall, this pilot study supports further development of a regionally adapted NOVA-UPF screener. The next step should include test-retest reliability and validation against repeated 24-hour recalls or multi-day dietary records in a larger and more balanced sample. Until then, the module offers a promising but exploratory framework for rapid assessment of ultra-processed food consumption frequency in adults.

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AUTORSKI NOVA-UPF FREKVENCIJSKI MODUL ZA PROCENU UČESTALOSTI KONZUMIRANJA ULTRA-PRERAĐENE HRANE KOD ODRASLIH: PILOT-STUDIJA

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Sažetak. *Procena unosa ultra-prerađene hrane predstavlja metodološki izazov, jer klasični instrumenti za procenu ishrane često ne razlikuju domaće, zanatske i industrijski formulisane varijante sličnih proizvoda. Cilj ove pilot presječne studije bio je da se ispita primenljivost, interna konzistentnost i preliminarne performanse autorskog NOVA-UPF frekvencijskog modula prilagođenog regionalnim prehrambenim navikama i dostupnim proizvodima. Anonimni online upitnik popunilo je 200 odraslih ispitanika. Modul je obuhvatio 15 kategorija ultra-prerađene hrane, bodovanih od 0 do 6 prema prijavljenoj učestalosti konzumiranja, čime je formiran preliminarni UPF frequency score teorijskog raspona 0–90. Uzorak su većinom činile žene (69,0%), ispitanici mlađi od 45 godina (72,5%) i osobe iz gradske sredine (65,0%). BMI ≥25 kg/m² imalo je 59,0% ispitanika, dok je najmanje jedan analizirani metabolički poremećaj prijavilo 41,5%. Posmatrani UPF skor kretao se od 0 do 60,*

sa srednjom vrednošću 20,84 ± 12,75, medijanom 19 i interkvartilnim rasponom 11–26. Interna konzistentnost modula bila je visoka (Cronbach's α = 0,882). Korigovane item-total korelacije bile su veće od 0,30 za 14 od 15 stavki, u rasponu 0,361–0,679; jedino su proteinske pločice, „fit" slatkiši i zamene za obrok imale nižu vrednost (r = 0,277), dok se α pri uklanjanju pojedinačnih stavki kretala od 0,868 do 0,884. Najčešće kategorije konzumirane najmanje jednom nedeljno bile su industrijski slatkiši (62,0%), industrijski sosovi i prelivi (53,0%), slane grickalice (52,5%), industrijski keks/napolitanke/vafli (52,5%), mesne prerađevine (48,0%), industrijski kolači i slatka peciva (47,5%) i zaslađeni gazirani napici (46,0%). UPF skor bio je viši kod muškaraca nego kod žena (medijana 24,0 prema 17,5; p = 0,002) i smanjivao se sa starošću (ρ = −0,325; p < 0,001), dok nije bio značajno povezan sa BMI kategorijom ni obrazovanjem. Modul pokazuje dobru primenljivost za brzi skrining i rangiranje učestalosti konzumiranja ultra-prerađene hrane, ali zahteva validaciju prema 24-časovnim prisjećanjima ili dnevnicima ishrane pre upotrebe kao instrumenta za procenu stvarnog unosa.

Ključne riječi: *ultra-prerađena hrana, NOVA klasifikacija, procena ishrane, frekvencijski skor, pilot-istraživanje.*