



Reliability and validity of a Hebrew-language short screening questionnaire for highly processed foods (HsQ-HPF)

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ABSTRACT

Background: Ultraprocessed food consumption has been linked to adverse health outcomes and is traditionally assessed through labor-intensive dietary intake methods. To facilitate efficient assessment, the short screening questionnaire of highly processed food consumption (sQHPP) was previously developed and validated in Spanish populations.

Objective: To translate, culturally adapt, and validate a Hebrew version of the sQHPP (HsQHPP) for use among Israeli adults.

Methods: In this cross-sectional study, adult participants completed a 24-hour dietary recall, the HsQHPP, and the Israel Mediterranean Diet Screener (IMEDAS). A subgroup repeated the HsQHPP after three weeks to evaluate reliability. Associations between HsQHPP scores, NOVA group 4 food items from the dietary recall, and IMEDAS scores were examined. Internal consistency, correlations, and intraclass correlation coefficients (ICC) were calculated.

Results: Forty-three adults participated (median age 25 years; 72.7% female). The HsQHPP exhibited excellent internal consistency (Cronbach's $\alpha = 0.74$). HsQHPP scores correlated strongly and significantly with the number of NOVA group 4 items from the 24-hour recall ($\rho = 0.727$, $p < 0.001$), supporting construct validity. No significant associations were

found with IMEDAS scores. Test–retest reliability was high (ICC = 0.81; 95% CI 0.58–0.92; $p < 0.001$). Higher HsQHPF tertiles were associated with significantly greater saturated fat intake and a higher number of NOVA group 4 foods.

Conclusion: The HsQHPF is a valid and reliable tool for evaluating ultra-processed food consumption in the Israeli adult population. Its use may streamline data collection in future studies examining associations between ultra-processed food intake and health outcomes.

Novelty of the study: The present study is the first to validate a tool for evaluating the intake of ultra-processed foods in adults in the Israeli population

Key Words: Validity; highly processed foods; questionnaire; methods

Validation of the Hebrew Version of the Short Questionnaire on Highly Processed Food Consumption (HsQ-HPF)



Background

Ultra-processed food consumption has been linked to adverse health outcomes.



Objective

To translate, culturally, adapt, and validate the HsQ-HPF for Israeli adults



Conclusions

The HsQ-HPF is a valid and reliable tool for assessing ultra-processed food consumption in the Israeli adult population.

Methods



Cross-sectional study of Israeli adults

- 24-hour dietary recall
- Re-testing after 3 weeks

Results



43 participants
Excellent internal consistency

- Correlation with NOVA Group 4 items
- High test-retest reliability (T-RTR)



Graphical Abstract: Reliability and validity of a Hebrew-language short screening questionnaire for highly processed foods (HsQ-HPF)

INTRODUCTION

The NOVA system categorizes food into four groups on the basis of its level of processing, ranging from unprocessed (Group 1) to ultra-processed (Group 4). Ultra-processed foods are industrially formulated using ingredients and processes that could not be duplicated in the home. Generally inexpensive, ultra-processed foods are energy-dense but nutrient-poor; often, they include refined starch, added sugars, salt and unhealthy fats while providing little protein, fibre, vitamins or minerals [1]. Intentionally, ultra-processed foods are extremely palatable with long shelf-life [2]. This palatability, together with their attractive packaging and marketing, tends to encourage overconsumption [3] and eating behaviors resembling addiction [4]. Further, exposure to food additives, such as artificial preservatives, have been shown to increase lipid peroxidation and mitochondrial dysfunction while suppressing antioxidant enzymes, leading to negative impacts on human health [5]. Examples of foods in Group 4 of the NOVA system include ready-to-eat meals; soft drinks (including artificially sweetened drinks); and packaged snacks [6].

Though worldwide trends in ultra-processed food consumption differ from region to region, consumption of these products has increased globally so that ultra-processed foods contribute an ever-increasing percentage of total energy intake. For example, ultra-processed food accounts for more than half of the total energy intake in the United States [7] and United Kingdom, between 20%-30% in France and Korea, and about 10% in Italy [8]. Even in the remote province of Sistan and Baluchistan in Iran, ultra-processed foods are consumed by more than 60% of adolescent girls at lunchtime [9].

The increase in ultra-processed food consumption has been associated with a variety of adverse health outcomes including obesity, diabetes, hypertension, cancer, cardiovascular disease, depression and anxiety [10, 11]. It has been proposed that the underlying mechanism explaining these associations includes low grade chronic inflammation. Indeed, ultra-processed food intake has been shown to be associated with markers of inflammation including white blood cell count, neutrophils, basophils, the neutrophil:lymphocyte ratio, interleukin 6 and tumour necrosis factor-alpha, associations mediated through body mass index and waist:height ratio [12].

The NOVA method requires the acquisition of dietary intake data using methods such as the 24-hour recall [13], food frequency questionnaire [14] or food diaries [15]. This labor-intensive approach requires collection and analysis of food intake, including the classification of the foods into NOVA groups. To streamline this process, the short screening questionnaire of highly processed food (sQ-HPF) was developed using data from the >4000 participants in the PREvention with MEDiterranean Diet (PREDIMED-Plus) cohort and was shown to be both valid and reliable [16]. The sQ-HPF requires translation, adaptation and validation for use in non-Spanish populations. Thus, the objective of the present study was to translate, adapt and validate the sQ-HPF for use in the general Israeli adult population.

METHODS

Study design: The present cross-sectional study examined dietary intake using a 24-hour, multi-pass dietary intake method of the Israel Ministry of Health

[17]. Reported foods were categorized into NOVA groups [6]. Simultaneously, participants completed the Hebrew version of the sQ-HPF (HsQ-HPF) and the Israel Mediterranean Diet Screener (I-MEDAS) [18]. In a subgroup of participants, the HsQ-HPF was repeated to estimate reliability.

Study population: The study population was comprised of a convenience sample of Israeli (18 years of age or older), men and women, who agreed to participate in the study. The ability to comprehend written and spoken Hebrew was necessary for study participation.

Sample size: The present study was designed such that 40 participants would provide 80% power to detect a true intra-class correlation coefficient of 0.45 or greater assuming a two-sided alpha of 0.05.

Ethical Considerations: The present study received approval from the Ethics Committee of Ariel University: AU-HEA-MB-20251216.

Translation of the sQ-HPF to Hebrew and Cultural Adaptation: The sQ-HPF as published in English was used as the basis for the present translation [16]. Two researchers, each both registered dietitians and nutritional epidemiologists, who are fluent in both English and Hebrew, translated the questionnaire from English into Hebrew. Additionally, the food items and frequency of consumption references of the sQ-HPF were modified to reflect Israeli dietary habits and food culture. The Hebrew language sQ-HPF (HsQ-HPF) was reviewed by other registered dietitians to obtain expert validity. Next, the HsQ-HPF was back-translated into English. The

accuracy and consistency of the translation and back-translation were evaluated by six registered dietitians fluent in both English and Hebrew. Small alterations were made in the questionnaire, and the final version was approved by all experts. The HsQ-HPF underwent a pilot evaluation and was finally judged appropriate for validation.

Dietary assessment

24-hour recall: The 24-hour dietary recall was carried out in Hebrew by a registered dietitian trained in the Israel Ministry of Health's standardized multi-pass interviewing technique [17]. This structured, in person interview includes the following stages:

1. **Pass 1:** The participant provides a complete list of all foods and beverages consumed from midnight to midnight the previous day.
2. **Pass 2:** The interviewer probes for any additional items eaten between meals.
3. **Pass 3:** Additional details are collected, such as preparation methods, portion sizes, and ingredients.
4. **Pass 4:** The participant reviews the information and makes any necessary corrections.
5. **Pass 5:** The interviewer verifies whether commonly overlooked items—such as drinks, snacks, alcohol, or supplements—were consumed.

Dietary intake reported using the 24-hour interview was recorded on paper and reviewed using the NOVA method to determine the number of food items in each of the NOVA groups.

NOVA: Each 24-hour recall was reviewed by a registered dietitian who assigned each food item to one of the four

NOVA groups. Recorded for each subject was the number of items in NOVA group 4 (ultra-processed foods), which is defined as industrially formulated products created using techniques not typically possible in a home kitchen. They are, by definition, characterized by high levels of salt, unhealthy fats and added sugars while being nutrient poor, and are designed to have an extended shelf life and to be highly palatable. Examples of such items include ready-to-eat meals, soft drinks (both sugar-sweetened and diet), and industrially prepared snack foods [6].

Israel Mediterranean Diet Screener (I-MEDAS): The I-MEDAS was developed to determine the degree to which an individual diet is similar to the Mediterranean diet, a measure of diet quality. With this screener, the response to a given question receives a value of 1 if the criterion was met, and 0 if the criterion was not met; thus, the total I-MEDAS score can receive a value from 0-17, where a higher score is consistent with better diet quality [19].

Test-retest (reliability): Three weeks following the first administration of the HsQ-HPF, the questionnaire was re-administered in a subgroup of participants using the same method (in-person interview).

Data analysis: Statistical analyses were performed using the SPSS 29.0. Distributions of continuous variables were tested for normality using the Kolmogorov-Smirnov test. Normally distributed variables are presented as mean \pm standard deviation, while those with distributions deviating from normal are described as median

(interquartile range). Nominal variables are reported as frequency (%). Cronbach's Alpha was calculated to determine whether questionnaire items measured the same construct. Associations between the HsQ-HPF scores and the number of items classed as NOVA Group 4 were described using Pearson's or Spearman's correlation coefficients, as appropriate for variable distributions. This method was also applied to determine associations between the HsQ-HPF scores and I-MEDAS scores. HsQ-HPF scores were converted to tertiles, and dietary intake was compared across these tertiles using ANOVA followed by LSD post hoc test. For test-retest assessment, intra-class correlations were calculated with 95% confidence intervals. All tests are two-tailed at considered significant at $p < 0.05$.

RESULTS

A total of 43 individuals participated in the study. The median (IQR) age of study participants was 25 (4); 32 (72.7%) were female; 13 (30.2%) reported smoking occasionally or daily; and 34 (79%) were studying or had completed a bachelor's degree or higher. On the average, respondents exercised 180 ± 119 minutes weekly.

Presented in Table 1 is the Hebrew language version of the sQ-HPF (HsQ-HPF, presented in English) with its accompanying scoring guide. The Hebrew language version differs slightly from the original Spanish version primarily by the exclusion of pork products (not consumed by most Israelis) and the examples of foods provided that reflect the food culture of Israel. The Cronbach's alpha for the 14 HsQ-HPF items was 0.74.

Table 1. Hebrew language screening questionnaire of highly processed food (HsQ-HPF) with scoring guide (presented in English).

Item	Score – a score of 1 point is given if the stated criterion is met for each item
1. How many times a week did you eat high-fat dairy products (for example, sour cream, yellow cheese, processed cheese)?	Twice a week or more
2. How many times a month did you eat sweet dairy products (for example, sweetened dairy beverages, sweetened yogurts or dairy desserts, chocolate milk drinks including protein-enriched products)?	Three times a month or more
3. How many times a day did you eat processed meat (for example, salami, pastrami, or hot dogs)?	Once a day or more
4. How many times a month did you eat fatty spreads (butter, margarine, animal fat)?	More than three times a month
5. How many times a day did you drink fermented alcoholic beverages (for example, red, white or rosé wine, beer)?	More than once a day
6. How many times a month did you drink distilled alcoholic beverages (liqueur, whisky, cognac, vodka, gin)?	More than three times a month
7. How many times a week did you drink sugar-sweetened beverages or diet drinks (soft drinks, including diet drinks or bottled juice)?	Twice a week or more
8. How many times a day did you eat sweets (ice cream/sorbet, chocolate, powdered chocolate drink, chocolate spread, canned fruit in syrup, biscuits, honey, homemade or commercially prepared pastries, donuts, muffins, cupcakes, cakes, or cookies)?	More than once a day
9. How many times a month did you eat savory snacks (Bamba, potato chips, pretzels, Bisli or microwave popcorn)?	More than three times a month
10. How many times a month did you eat ready-to-eat foods/ready made (pizza, ready made chicken or corn schnitzel, Tivol, instant meals, jahnun, frozen borekas or frozen French fries or onion rings)?	More than three times a month
11. How many times a week did you eat refined grains (white bread, pasta, couscous, noodles, white rice)?	Twice a week or more
12. How many times a week did you eat ready-made/ready-to-eat spreads/condiments (mayonnaise, ketchup, prepared tomato sauce, Teriyaki sauce, sweet chili sauce, Thousand Island dressing, garlic sauce)?	More than once a week
13. How many times a day did you consume food additives (sugar, artificial sweeteners, honey, date syrup (silan), maple syrup, or salt)?	More than three times a day
14. How many times a week did you eat deep fried foods, whether homemade, commercial, or outside the home (for example, French fries, onion rings, chicken nuggets, falafel, fried cauliflower, fried eggplant)?	Twice a week or more

Figure 1 presents the correlation between HsQ-HPF scores and the number of food items from the 24-hour dietary recall classified within NOVA group 4. As can be seen, the correlation is positive and significant, rho=0.727, p<0.001. However, the associations between

the HsQ-HPF score and the I-MEDAS score were negative but not significant: Rho=-0.149, p=0.351. Similarly, the association between I-MEDAS and the number of NOVA group 4 items identified in the 24-hour recall was also negative but not significant: Rho=0.139, p=0.424.

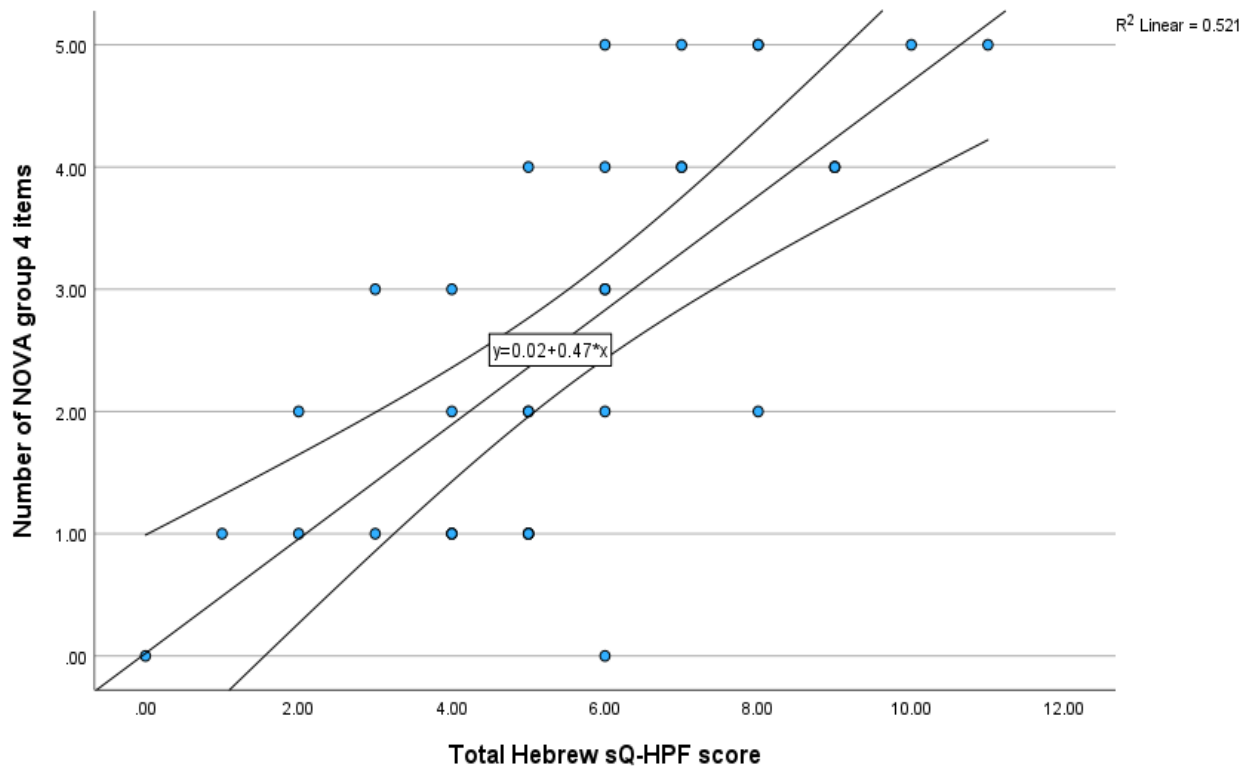


Figure 1. The correlation between the total Hebrew language screening questionnaire of highly processed food (HsQ-HPF) score, and the number of NOVA Group 4 food items identified from the 24-hour dietary recall

The distributions of number of NOVA Group 4 items and the I-MEDAS score deviated significantly from normal, so associations were described by calculating the Spearman’s rho correlation coefficient.

Table 2 displays the comparisons of nutrients and participant characteristics across tertiles of HsQ-HPF scores. Both grams of saturated fat consumed and the number of food items classed as NOVA group 4 differed significantly across HsQ-HPF tertiles, driven by significantly higher values in the highest tertile of HsQ-HPF tertile than either of the other tertiles. Driven by significantly lower values in the highest HsQ-HPF tertile

was the percentage of females, indicating a greater proportion of men than women in this group.

Reliability was tested by repeating the HsQ-HPF approximately three weeks after its original administration in a subgroup of participants (n=21). The intraclass correlation coefficient for single measures was 0.81 (95% CI 0.58-0.92), p<0.001, as shown in Figure 2.

Table 2. Comparison of dietary intake and demographic characteristics across tertiles of the Hebrew version of the short screening questionnaire of highly processed food (HsQ-HPF) scores

Intake item	HsQ-HPF tertile 1 (score < 4, n=15)	HsQ-HPF tertile 2 (score 4-6, n=7)	HsQ-HPF tertile 3 (score > 6, n=20)	p-value
Dietary Measures				
Energy (kcal)	1638.8 ± 368.6	1443.2 ± 224.4	2195.9 ± 979.9	0.11
Protein (gr)	113.9 ± 59.8	102.4 ± 26.8	144.8 ± 89.8	0.46
Total fats (gr)	57.4 ± 16.4	55.5 ± 9.2	79.5 ± 31.1	0.08
Total saturated fats (gr)	16.9 ± 5.3	15.5 ± 1.5	26.9 ± 12.1	0.03
Total carbohydrates (gr)	176.7 ± 45.4	139.4 ± 54.5	223.7 ± 110.8	0.17
Dietary Fiber (gr)	22.1 ± 7.2	14.1 ± 3.5	18.9 ± 8.3	0.19
Items in NOVA group 4	1.5 ± 0.9	1.7 ± 1.1	2.6 ± 1.6	<0.001
Total I-MEDAS score	9.3 ± 1.5	9.1 ± 2.6	9.0 ± 2.1	0.95
Total sQ-HPF score	3.1 ± 1.3	5.0 ± 0	7.6 ± 1.5	<0.001
Participant Characteristics				
Age (years)	32.0 ± 19.9	33.4 ± 17.2	26.5 ± 7.1	0.41
% Female	86.7%	100%	55%	0.02
% Current Smoker	20.0%	28.6%	40.0%	0.44
Minutes of exercise/week	210.7 ± 113.4	175.7 ± 62.7	155.9 ± 137.8	0.42
% University education	73%	100%	90%	0.19

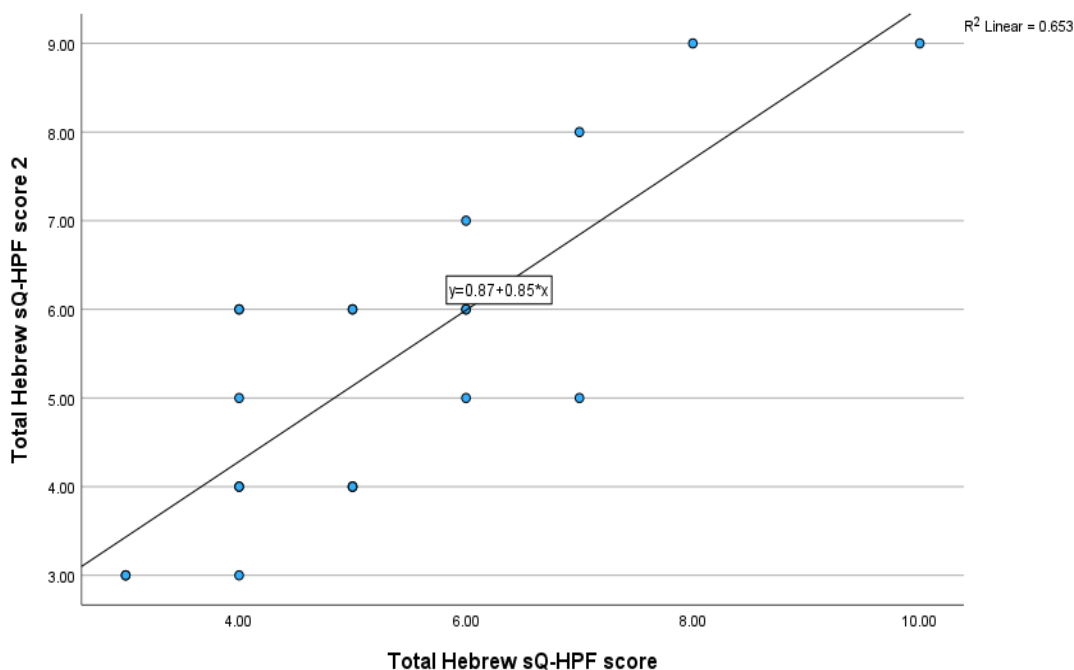


Figure 2. The intra-class correlation coefficient describing the association between the first and second administration of the short screening questionnaire of highly processed food (HsQ-HPF) scores

DISCUSSION

The present study was designed to evaluate the validity and reliability of the HsQ-HPF, modified from the original Spanish sQ-HPF, translated to the Hebrew language and adapted to Israeli food culture. The internal consistency of the questionnaire items was evaluated using Cronbach's alpha (0.74), higher than the value reported in a validation study of the sQ-HPF in Turkish [20]. However, like the original questionnaire, the HsQ-HPF included 14 questions, while the Turkish version included 11 items. Scoring for the HsQ-HPF was identical to the original questionnaire. Examples of food items listed in the questionnaire, however, were altered to reflect Israeli sensibilities and preferences. Further, the 24-hour recalls, and all questionnaires were administered by trained, registered dietitians with extensive experience in assessing food intake patterns, thereby enhancing the accuracy of the intake estimates and improving the agreement between items and methods.

The purpose of validating the HsQ-HPF is to streamline data collection regarding ultra-processed foods in study populations. Typically, the determination of dietary processing level requires the use of a dietary intake method such as a 24-hour recall, as in the present study and others, or food frequency questionnaires or food diaries [21-24]. Each of these methods has specific limitations, but they are all labor-intensive, which adds to the costs of conducting studies. The development of a direct measure of ultra-processed food intake would make it easier to conduct studies of food-disease associations.

The present study identified very good agreement between the first and second administration of the HsQ-HPF (reliability) and between the number of NOVA group 4 items on the 24-hour recall and the HsQ-HPF score. The I-MEDAS score, however, was not significantly associated with the HsQ-HPF score, though the correlation coefficient was negative. The I-MEDAS score was also not significantly associated with the number of items in

NOVA group 4. The I-MEDAS was included in the present study as an estimate of diet quality, though it does not focus on the degree of food processing. Moreover, it is possible to consume a diet that includes ultra-processed foods but nevertheless conforms overall to a Mediterranean diet pattern including intake of olive oil, fish, nuts, fruits and vegetables (not queried in the HsQ-HPF) [25].

Overall, nutrition intake did not significantly differ across tertiles of HsQ-HPF scores, with the exception of saturated fat (grams per day), driven by significantly greater intake of this nutrient in the highest HsQ-HPF.

In addition to good validity, reliability was shown to be good, with a single measure intra-class correlation coefficient 0.81 (95% CI 0.58-0.92), $p < 0.001$.

A reliable and valid questionnaire will facilitate research by streamlining data collection on the consumption of ultra-processed foods. The importance of this cannot be understated, since the association between ultra-processed food intake and diet-related adverse health outcomes, particularly non-communicable disease including cardiovascular disease, cancer, diabetes, obesity, depression and anxiety has been suggested [11, 27, 28]. By contrast, plant-based, whole food diets have consistently been shown to reduce both cardiovascular and cancer morbidity [29] while simultaneously promoting longevity and well-being [30, 31].

Strengths and Limitations: Both reliability and validity were assessed in the following study, using widely accepted methods. The 24-hour dietary intake interview, I-MEDAS, and NOVA scoring were all conducted by registered dietitians who were highly trained and very experienced in the study methodology. This enhances the quality and thoroughness of participant responses. Findings suggest that the items in the HsQ-HPF are well-aligned and that the total score is strongly associated with the number of NOVA grade 4 items. This implies that

the questionnaire indeed measures ultra-processed food intake in the general Israeli population.

Findings of the study must be considered in the framework of study limitations. First, the study population was comprised of 72.2% women, suggesting that the participants do not represent the Israeli population. Further, the study population had a median age of 25.0 (4.0) years, which is slightly younger than the median age of 31.6 years reported in 2023 [26], again indicating that the study sample, which was recruited using convenience sampling, may not be representative of the general Israeli population.

While the study was powered to detect a correlation coefficient of 0.45 or greater, it was underpowered to detect smaller correlation coefficients. It is conceivable that weaker associations would have reached statistical significance had a larger sample been recruited.

CONCLUSIONS

The present study is the first to validate the HsQ-HPF for use in the general Israeli population.

Evaluating the association between ultra-processed food intake and these outcomes forms the evidence base from which public health nutrition policy can be formed. The HsQ-HPF is a reliable and valid method for measuring the consumption of ultra-processed foods in the Israeli population.

List of Abbreviations:

- 95% CI – 95% Confidence Interval
- HsQ-HPF – Hebrew language short screening questionnaire of highly processed food consumption
- ICC – Intraclass correlation coefficient
- I-MEDAS – Israel Mediterranean Diet Screener
- IQR – Interquartile range
- sQ-HPF – short screening questionnaire of highly processed food consumption

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