Eating out intensity, ultra-processed foods and body mass index among Albanian youth

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Authorship

EL was responsible for research design, implementation and methodology; FV, TM and FE provided technical input for methodology; EL and FV were responsible for data collection and analysis, with assistance from TM and FE; EL, FV, TM and FE contributed to drafting the article and revising it critically for important intellectual content. All authors contributed to and approved the final version of this manuscript.

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Conflict of interest disclosure

The authors have no conflicts of interest relevant to this article to disclose.

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Ethical approval

All participants were informed before giving their written consent and participating in the study. The study protocol and methods were approved by the Medical Ethics Committee of Ghent University (EC/2015/1118), the Directorate of Health Care at the Ministry of Health in Albania (MSH/2015/LL-13-1) and the Ethics Committee of the University of Medicine Tirana (ELL-2016) in line with the Declaration of Helsinki guidelines.

Abstract

Objective: Ultra-processed foods (UPFs) and eating out of home (OH) are changing nutrition, particularly among youth in constrained settings. We aimed to assess the role of eating OH intensity on the associations of UPFs and unprocessed/minimally processed foods (UMPFs) with body mass index (BMI) among Albanian youth.

Design: Cross-sectional.

Setting: Albania, a south-eastern European country.
Participants: 281 youth, predominantly females.

Methods: UPFs and UMPFs were defined based on NOVA, while eating OH intensity based on energy percentage from OH foods. Multivariable models tested associations of UPFs and UMPFs with BMI stratified by eating OH intensity, controlled for relevant covariates including diet quality, portion size and costs.

Results: The respondents age ranged between 18-23 years with a female predominance(87.5%). Mean energy from UPFs and UMPFs was 846(SD:573.0) and 802.9(422.5)kcals, respectively. Among substantial at home eaters UPF intake was not associated (β=-0.07,95%CI:-0.13;0.267) with BMI, however UMPFs negatively associated with BMI (β=-0.24,95%CI:-0.43;-0.06). Among those defined as substantial out of home eaters, UPFs (β=0.24, 95%CI:0.08;0.40) and UMPFs (β=0.18,95%CI:0.04;0.33) were positively associated with BMI.

Conclusions: Our findings provide evidence for the hypothesis that eating OH plays an important role in the association of UPFs and UMPFs with BMI in youth. While causality cannot be established due to cross-sectional design, to the best of our knowledge, we provide the first assessment of UPFs and UMPFs intake in a south-eastern European setting, while highlighting the need for establishing and integrating youth nutrition into national nutritional surveillance systems for key dietary risk factors in Albania.

Key words: Ultra-processed foods; eating out of home; youth; BMI; Diet quality.

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Introduction

Consumption of ultra-processed foods (UPFs) has been strongly associated with poor diet quality[1], greater risk of diet-related noncommunicable diseases[2,3] and all-cause mortality[4]. UPFs consumption accounts for over a half of total energy intake in multiple countries and is rapidly increasing worldwide[5], particularly among younger age groups[6,7]. There is evidence that these trends are associated with detrimental shifts in body size and composition [8,9] and *ad libitum* intake[10] in this age group. In contrast, consumption of unprocessed or minimally processed foods (UMPFs) has been associated with favourable patterns of protein intake, diet quality and lower cardiometabolic risks[11].

Youth – the transition from adolescence to adulthood – is a time of rapid changes in physical growth and development, as well as cognitive and emotional capacities[12]. While there has been a great emphasis on early childhood nutrition in the field, it is important to recognize that youth phase also presents risks and opportunities, accompanied with long-term and intergenerational consequences.

Yet, youth nutrition has been overlooked in the UN Decade of Action on Nutrition (2016-25) and the Sustainable Development Goals for nutrition, as they do not contain any youth-specific nutrition targets[13]. The Global Action Plan of the World Health Organization for the prevention and control of noncommunicable diseases also lacks clearly specified targets for overweight and obesity in youth[14]. Despite the fact that overweight and obesity among youth more than doubled globally from 1990 to 2016 and the number of young girls with anaemia increased by 20% [15], investments in and research for youth nutrition remain woefully inadequate. As day follows night, diet-related noncommunicable diseases inevitably follow overweight and obesity, highlighting the importance of scrutinizing the role of UPFs consumption in youth nutrition and disease prevention. This urgency is reinforced by high-quality meta-analyses of large prospective cohort studies that have demonstrated a robust association between UPFs consumption and the risk of type 2 diabetes[16].

Accumulating evidence indicates that consumption of UPFs and convenience meals have increased recently[17], alongside a parallel trend and rapid expansion of eating out of home (OH). This has been partially fuelled by the digitalization and commercialization of youth health and wellbeing on social media[18], particularly in the World Health Organization

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European Region[19]. Consumption of UPFs has been linked to eating location[20], raising concerns about the link between eating OH intensity and UPFs. This link becomes especially important when considering the impact of UPFs not only on human, but also on environmental health and sustainability[21].

Recognizing that accelerated global action is needed to address the pervasive and corrosive burden of malnutrition in all its forms, the Global Nutrition Report regularly reports on progress in nutrition for all countries and regions. The latest report, shows that not a single country in the south-eastern Europe is on course to meet the targets for obesity among men and women[22]. In line with Global Nutrition Report, the latest Global Burden of Disease study on health effects of dietary risks, estimated that a relatively high proportion of deaths among adults in this part of Europe in 2017 were attributable to dietary risks (i.e., 32%[95%CI:29.7-34.3])[23].

Among youth, data are scarce, virtually non-existent in Albania (i.e. an upper middle-income south-eastern European country of the Mediterranean basin). The latest '*2022 Report of the European Commission'* has highlighted the critical state of malnutrition in Albania and the pressing need to develop a nutrition plan and the urgency to raise awareness on dietary risks[24]. To the best of our knowledge, there has been no quantified dietary intake data available for youth or other population groups in Albania in the past 30 years, including data on UPFs consumption. The only quantified dietary intake data available for Albania has been published recently by our research group[25,26]. In these studies, we have indicated an extremely poor adherence to established standards and guidelines for health and environmental sustainability, while highlighting the distressing presence of dietary risks.

Here, we conduct the first analysis on UPFs and UMPFs consumption in relation to eating OH intensity and evaluate their association with body mass index (BMI), taking into consideration food costs and diet quality indices considered healthy and sustainable among youth in Albania.

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Methods

The present analysis is based on observational data collected cross-sectionally in Albania[25].

Study design and sample

Dietary intake data were collected using a single multiple pass 24-hour dietary recall and processed with Lucille Food Intake platform hosted by Ghent University. The 24-hour dietary recall was conducted using the validated multiple pass method described in our previous work[25]. In brief, the instrument uses a standardized methodology to make recall of all possible foods as accurate as possible and address recall bias. In addition, students of Master of Public Health, at the University of Medicine Tirana were recruited and trained on the use of 24-hour instrument. The study included young adults (18–23 years) sampled from the three largest universities in Albania (36-38% of county's undergraduate students were studying there during data collection), namely University of Tirana, University of Medicine Tirana and Polytechnic University of Tirana.

To be eligible for inclusion in the study, participants had to be enrolled in an undergraduate program at one of the aforementioned universities. This criterion intended to exclude students enrolled in postgraduate programs, who were often working whilst studying and were thus not in regular contact with the typical food environment. However, some special programs were included despite of this restriction, since they had an integrated master of science program (e.g. medicine, pharmacy, dentistry and architecture).

In brief, 364 participants were initially invited. A total of 35 participants reported that the recall day was not representative of a typical day and were therefore excluded. Of the remaining 326 participants, 11 were excluded due to health issues (i.e. flu, common cold, etc.) on the day prior or during the past 24 hours. Further, 26 participants wanted to do the recalls, but did not give their consent for their recall information to be included in our analyses and were therefore not considered further. A more detailed description of study design, validation of the recall instrument and analysis of the food environment have been published elsewhere[25,26].

A priori high and low sex-specific cut-off points were established for plausible energy intake and three cases that fell outside of the cut-offs were excluded. Eventually, 289 remaining participants were considered (response proportion: 79.4%). During the data-cleaning process,

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the sample was further restricted to only those respondents with valid and non-missing data for UPFs (excluding 8 participants), resulting in a final sample of 281 participants for data analysis presented in this report (**Figure 1**). Sensitivity analysis of the excluded participants showed that their exclusion did not affect the investigated associations (not shown).

Ethical approval

All participants were informed before giving their written consent and participating in the study. The study protocol and methods were approved by the Medical Ethics Committee of Ghent University Hospital (No. EC/2015/1118), the Directorate of Health Care at the Ministry of Health and Social Protection in Albania (No. MSH/2015/LL-13-1) and the Ethics Committee of the University of Medicine Tirana (No. ELL-2016) in line with the Declaration of Helsinki guidelines.

Degree of processing, composition and food cost data

All food and drink items were classified according to the NOVA system into UMPFs and UPFs[27]. UMPFs were those that were altered only by removing inedible or unwanted parts, drying, crushing, grinding, fractionating, filtering, roasting, boiling, pasteurization, refrigeration, freezing, placing in containers, vacuum packaging or non-alcoholic fermentation, without adding any other ingredients. A few examples include fresh fruits and vegetables, boiled eggs and untreated nuts or seeds. UPFs were identified when food substances never or rarely used were found among the list of ingredients. Some of those substances include different types of sugars (fructose, high fructose corn syrup, 'fruit juice concentrates', inverted sugar, maltodextrin, dextrose, lactose), modified oils (hydrogenated or inter-esterified oils), protein sources (hydrolysed proteins, soy protein isolate, gluten, casein, whey protein and 'mechanically separated meat'), as well as additive cosmetics used for aroma, flavour enhancers, dyes, emulsifiers, among other applications. Some examples include energy drinks, packaged snacks, (e.g. chips and most crackers) and processed meats like cold cuts or sausages.

Data on food intake was coupled with price data of each individual food item to estimate diet cost. Prices in Albanian LEK were obtained from local fast-foods, supermarkets, restaurants and other food vendors around the university facilities where the data collection was

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performed and were converted in Euro (€) based on the conversion rate at the time the study was conducted (i.e. 1 € = 135,21 Albanian LEK).

Definition of eating out of home

Eating OH may be defined by either the place of consumption or source of food. In the literature, '*eating out of home'* and '*away from home eating*' tend to be used interchangeably. Both concepts refer to the same notion of practices, involving foods and drinks prepared OH. We considered OH foods to include foods that were not prepared at home and were obtained near fast foods, restaurants, street food vendors and other OH sources of food, including food products purchased ready-to-eat from food stores, such as supermarkets, convenience stores and some special food market. To define eating OH intensity, participants were classified as '*substantial at home (AH) eaters*' if equal to or less than 30% of their total dietary energy intake came from foods and drinks prepared OH and as '*substantial OH eaters'* if this percentage was higher than 30%.

Dietary indices and scores

Adherence to the Mediterranean diet score was computed according to the KIDMED index developed by Serra-Majem and colleagues for subjects up to 24 years old[28]. The index is based on a 16-question test and the score ranges between 0-12 , founded on principles that sustain a Mediterranean dietary pattern, as well as those that undermine it. Questions denoting a negative connotation with respect to the Mediterranean diet were assigned a value of -1(e.g. eating at a fast-food restaurant, takes sweets and candy several times every day), and those with a positive aspect +1(e.g. use of olive oil, likes pulses and eats them more than once a week). The sums of the values can be interpreted as three levels of adherence: (1)≥8, optimal Mediterranean diet; (2)4–7, improvement needed to adjust intake to Mediterranean patterns; (3)≤3, very low diet quality and adherence to Mediterranean dietary pattern.

The DASH score was calculated as previously done by Mellen and colleagues based on nutrient targets derived from DASH trials (i.e., targets for saturated fat, total fat, protein, cholesterol, fibre, magnesium, calcium, potassium and sodium)[29]. In our analyses, individuals who met the goal for each component received 1 point (e.g. protein up to 18% of total energy or magnesium no less than 238 mg/1000kcal), those who met an intermediate goal (e.g. saturated fats up to 11% of total energy intake or cholesterol below 107.1 mg/1000kcal), defined as the midpoint between the DASH diet goal and the nutrient content

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of the DASH control diet received 0.5 point and those who met neither goal received 0 points. A total score was generated by considering all nutrient components, resulting in a minimum of 0 and a maximum of 9 points.

World Health Organization guidelines for the prevention of chronic diseases[30] and the World Health Organization 2020 Updated Healthy Diet Fact Sheet[31] were used to construct a modified version of the Healthy Diet Indicator, using seven nutrient standards (i.e. saturated fatty acids, polyunsaturated fatty acids, total protein, total dietary fibre, monosaccharides and disaccharides, cholesterol and potassium). Further, individual scores were summed and participants received a maximum Healthy Diet Indicator score of 7 points, if all Healthy Diet Indicator targets were met and a minimum of 0 points if none was met (final scores ranged between 0-7).

Dietary intake data were also compared to the EAT-*Lancet* reference diet for healthy diets from sustainable food systems[32]. The EAT-*Lancet* score (0-14 points) was calculated based on adherence to 14 key dietary recommendations, as described by Knuppel and colleagues[33].

Anthropometric assessment

A mechanical scale was used for weight and a simple measuring tape for height. Height and weight were measured under the supervision and assistance of trained interviewers and for reliability, the measurements were taken in duplicate. A third measurement was performed if the first two measurements differed by > 200 grams for weight and > 2 cm for height. BMI was calculated as weight (in kilograms) divided by height (in meters) squared.

Statistical analysis

Descriptive analysis was presented using the computed means and standard deviations (SD) of the relevant variables. We compared the participants' characteristics by two eating OH intensity categories, i.e. *substantial AH* vs. *substantial OH eaters* using Mann-Whitney test.

Spearman's correlation was performed to measure the strength and direction of monotonic association between variables used in regression models. Multivariate linear regression analyses were performed in two steps for exploring the associations between energy intake from UPFs and UMPFs based calorie intake and BMI. Distribution of variables with a non-normal distribution were normalized by Box–Cox transformation. The minimally adjusted

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(Model 1) model testing the association between BMI(outcome) and UPFs and UMPFs(exposures), were controlled for age and sex. For the same association, a fully adjusted multivariable model (Model 2) was additionally controlled for diet quality scores, portion sizes and diet costs. Associations were quantified by standardized regression coefficients (β) and the corresponding 95% confidence interval(95%CI). Sensitivity analyses of sex as a potential moderator of the association between UPFs/UMPFs consumption and BMI among youth OH vs. AH settings showed negligible effects (not shown).

Statistical analysis was performed using *R* software version 4.0.5. We report results in accordance with STROBE (*STrengthening the Reporting of OBservational studies in Epidemiology*) extension for nutrition and dietary assessment[34].

Results

Participant characteristic

Table 1 summarizes the respondents' characteristics. There was a female predominance (i.e., males:12.5% vs. females:87.5%) and more than 60% of the sample was characterized as substantial OH eaters. The mean (±SD) BMI was 21.3 kg/m^2 (±2.8) and mean energy intake from UMPFs and UPFs was 802.9 kcals (±422.5) and 846 kcals (±573), respectively. Mean energy intake from UPFs was significantly higher among substantial OH eaters (mean$_{OH}$=1020.9 kcals, SD:±602.6) compared to substantial AH eaters (mean$_{AH}$=543.6 kcals, SD:±354.4). Adherence to Mediterranean diet (mean$_{AH}$=5.8, SD:±1.9; mean$_{OH}$=3.6, SD:±2.0) and DASH (mean$_{AH}$=4.0, SD:±1.2; mean$_{OH}$=3.2, SD:±1.1) were significantly higher among substantial AH eaters. Further statistically relevant differences could not be found between the two groups. (**Table 1.**)

In **Figure 2**, eating OH intensity was strongly and positively correlated with UPFs intake. Mediterranean diet score and DASH diet score were negatively correlated with UPFs intake. Correlations of the rest of the variables with UMPFs or UPFs intake were weak or negligible.

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Association of ultra-processed and unprocessed/minimally processed foods intake with body mass index

Overall, a strong positive association between energy intake coming from UPFs and BMI was observed both in minimally adjusted (β=0.16, 95%CI:0.04;0.27) and fully adjusted multivariable model (β=0.21, 95%CI:0.08;0.34) (**Table 2**). For UMPFs, overall there was a significant association with BMI in the minimally adjusted model (β=0.12, 95%CI:0.01;0.23), but it did not persist in the fully adjusted model for UMPFs (β=-0.03, 95%CI:-0.08;0.14).

Among substantial AH eaters, the only significant association observed was in the fully adjusted multivariable model, indicating an inverse association between UMPFs intake (β=-0.24, 95%CI:-0.43;-0.06) and BMI. No additional significant associations were observed in this subgroup for UPFs or UMPFs and the BMI as an outcome.

Among substantial OH eaters, the minimally adjusted model showed that energy intake from both UPFs (β=0.22, 95%CI:0.08;0.36) and UMPFs (β=0.26, 95%CI:0.13;0.40) was significantly associated with increased BMI. These associations for both UPFs (β=0.24, 95%CI:0.08;0.40) and UMPFs (β=0.18, 95%CI:0.04;0.33) with BMI persisted in the fully adjusted model.

Discussion

During the transition to adulthood, youth's main influences on diet gradually shift from mainly parents and family to schools, peers and friends, as well as food marketing and broader social forces. The present study provides new insights for youth nutrition and a first assessment on UPFs and UMPFs intake in south-eastern Europe, specifically Albania. The intensity of eating OH modifies the association between UPFs/UMPFs consumption with BMI. Those who have higher percentage of energy coming from OH had almost double the calories from UPFs. This may mean that those who eat more OH consume meals rich in UPFs and a higher BMI might be more strongly associated with UPFs consumption than those who eat less OH. Intensity of eating OH can modify the association between UPFs intake and BMI, by potentially amplifying UPF intake, and consequently, its impact on BMI. While individual choices and the broader food environment unquestionably exert significant

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influence on dietary patterns, it in noteworthy that a higher intake of UMPFs was inversely associated with BMI among AH eaters.

To the best of our knowledge, there are currently no published data on the consumption of UPFs among youth in the Balkans and/or south-eastern Europe that can be compared to our results. On this note, south-eastern European nations share cultural and historical connections, yet each holds distinct socioeconomic, dietary and lifestyle traits affecting UPF consumption. Our findings might not fully be transferable to all these nations, but they offer more relevant insights than findings extrapolated from Western/Central Europe or the United States, given the differing contexts. However, studies conducted on adults in Europe have shown a dramatic increase in the consumption of UPFs in recent years, with UPF potentially contributing up to half of total daily energy intake in many countries[35,36]. For example, a survey conducted in Italy between 2010-2013 found that UPFs made up nearly a quarter of total daily energy intake among children and young adults[37]. In concert these data suggest that UPFs are displacing long established dietary patterns and have become a major part of diets in Europe.

Moreover, the results of this study are in line with previous research of higher methodological rigor that has found strong associations between UPFs consumption and increased risk of obesity. For example, the only randomized controlled feeding study on diets rich in UPFs (2-week crossover design)[38] found that an UPF-based diet led to higher energy intake and consequently weight gain compared to the control, i.e. UMPFs-based diet. Several prospective cohort studies in adults have also found a connection between higher UPFs consumption and increased risk of obesity[39-41]. A longitudinal analysis nested in the PREDIMED-Plus trial found that higher consumption of UPFs was associated with greater age-related visceral and overall adiposity accumulation[42]. Analysis of data from 19 European countries also showed that the prevalence of obesity at national level was positively correlated with national household availability of UPFs[43].

Furthermore, a narrative review on UPFs (also defined by NOVA system) applied Bradford-Hill's criteria to evaluate causality in epidemiological studies linking them to weight gain and obesity[44]. Based on these criteria, the evidence in this review showed consistency, temporality, biological gradient, plausibility, coherence and experiment. In contrast to our findings and higher quality studies, cross-sectional studies in other continents have not found

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strong associations between UPFs intake and parameters of obesity and adiposity[45,46]. Such variation can be attributed to contextual factors and food system interface, but it should be investigated by future studies.

Of note, the available evidence has shown a link between UPFs consumption and increased BMI, but mostly in high income countries. However, our study adds to the growing body of evidence that UPFs consumption is increasingly prevalent among less developed countries of the Mediterranean basin. There is an emerging agreement in the scientific literature (including the results of the present study) that individuals with higher adherence to the Mediterranean diet tend to consume less UPFs. For instance, a study in Spain, that used the same scoring system (i.e., KIDMED) found that one third (i.e., 32.2%) of total energy intake came from UPFs and that UPFs consumption was inversely associated with higher adherence to the Mediterranean diet[47]. This particularly relevant for Albania, a Mediterranean basin country where 44% of its population is estimated to be unable to afford a recommended diet, a higher proportion than any other country in the same modernizing and formalizing group[48].

Based on our results, eating OH intensity appears to be an important driver of diet, along with the degree of processing. In our analysis, UPFs intake was higher among substantial OH eaters and strongly associated with higher BMI, but this association among OH eaters held true also in case of UMPFs. Results from a study in Brazil have suggested consumption frequency of UPFs can be higher when eating OH than when eating AH[49]. A study of adolescents in the United Kingdom, based on data from the National Diet and Nutrition Survey Rolling Program, showed that eating AH (β=-0.12, 95% CI: -0.19;-0.05) was inversely associated with UPFs consumption, while fast food consumption (β=0.29, 95% CI: 0.12;0.47) was directly associated with increased UPFs consumption[20]. While cross-sectional studies on the relationship between intake and body size are often hampered by the inaccuracies of food intake measurement methods, larger and better-controlled studies on the topic suggest that eating more UPFs away from home is associated with increased BMI and unfavourable changes in body fatness. We speculate that one potential explanation may be, that individuals eating more UMPFs are eating fewer UPFs to compensate for low physical activity or high sedentariness in the potential underlying mechanisms of the association. This warrants further investigation.

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It is important to note that the NOVA classification system, divides foods into categories based on the extent, nature and purpose of industrial processing. Since its publication in 2010, NOVA has been endorsed by international organizations such as the Pan American Health Organization and UN Food and Agriculture Organization, as UPFs have an impact on not just human health, but also the environment. However, the degree of food processing is not the sole determinant of nutritional quality. In some cases, processing may increase the bioavailability of nutrients and some foods in the NOVA classification can be prepared AH or in industrial settings. While more research is needed in this area, there is adequate evidence to recommend avoidance of UPFs in order to optimize health and diet quality, as well as to integrate such narrative in public health nutrition policies and guidelines. Further research on the nutritional values of UPFs and UMPFs compared to established or emerging nutritional guidelines and standards, as well as their link to risk markers for diet-related non-communicable diseases, is also warranted.

It is timely for policy makers and public health professionals in Albania to address youth nutrition as a priority. This may involve promoting the consumption of UMPFs or regulating the availability and affordability of UPFs, as well as interventions to reduce their production and supply. Overall, addressing youth nutrition in Albania is crucial for the long-term health and well-being of the country's young people.

This study provides a first look on UPFs intake in a population and setting that has not been studied before, allowing an opportunity to examine the interrelationships between nutritional status, UPFs intake and BMI among youth. However, there are some limitations that should be recognized. Our observations are based on a cross-sectional study design and a single multiple-pass 24-hour diet recall. While this tool is a valid approach for assessing dietary intake patterns in epidemiological studies, it is important to recognize that this approach may not fully capture long-term or seasonal variation in dietary patterns, in the populations under investigation. Previous studies predominantly among children or adults found, screen time, physical activity, mental health may be correlated with each other, with UPFs consumption, and also BMI[27,50]. In the critical evaluation of the results it should be also mentioned, that the statistical analysis did not consider potential confounding factors (e.g. physical activity, screen time, and the mental health of youth), that may have overestimated the observed associations between UPFs and BMI. In addition, recall and classification bias may exist in a self-report survey, but this challenge cannot be fully avoided, and we can assume that the

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amount of information bias is comparable to that of other similar epidemiological surveys. For instance, depending on the nature of the bias, if participants underreport UPFs consumption, but have high BMI, the association would appear weaker and if they overreport, the opposite can happen. Another limitation here is generalizability, as data come primarily from predominantly female university students, which may not be representative of the entire Albanian youth population. However, the data do highlight that dietary quality among youth in university settings is of poor quality and it's possible that the situation may be worse in the general population. It needs to be stressed that BMI alone is not a reliable indicator of health outcomes, and other factors, such as body fat distribution, also play a significant role. The association of UPFs with BMI may be bi-directional, as people with higher BMI may also be more likely to consume UPFs, which in turn can further deteriorate their body weight and composition. This possibility should be explored in future, ideally longitudinal, studies. An important consideration for such future studies should be incorporating UPFs, weight history, body composition, clinical outcomes and undermeasured consequences of weight gain (e.g. psychological toll of obesity), to fully characterize diet-BMI-health interactions.

Conclusion

Our findings provide evidence for the hypothesis that eating OH plays an important role in the association of UPFs and UMPFs with BMI, while showing that UPFs are unfavourably linked to BMI. While causality could not be established due to cross-sectional design, to the best of our knowledge, we provide a first assessment of UPFs and UMPFs intake in south-eastern Europe, while highlighting the need for establishing and integrating youth nutrition into national surveillance and monitoring systems for key dietary risk factors in Albania. Our design can be used as baseline for future studies investigating malnutrition in all its forms and the role of UPFs in this region. Although more research is needed to better understand the role of UPFs in body weight and composition changes, we advocate for the inclusion of diet's degree of processing in nutrition discourse and guidance targeting youth nutrition, particularly in the context of Albania.

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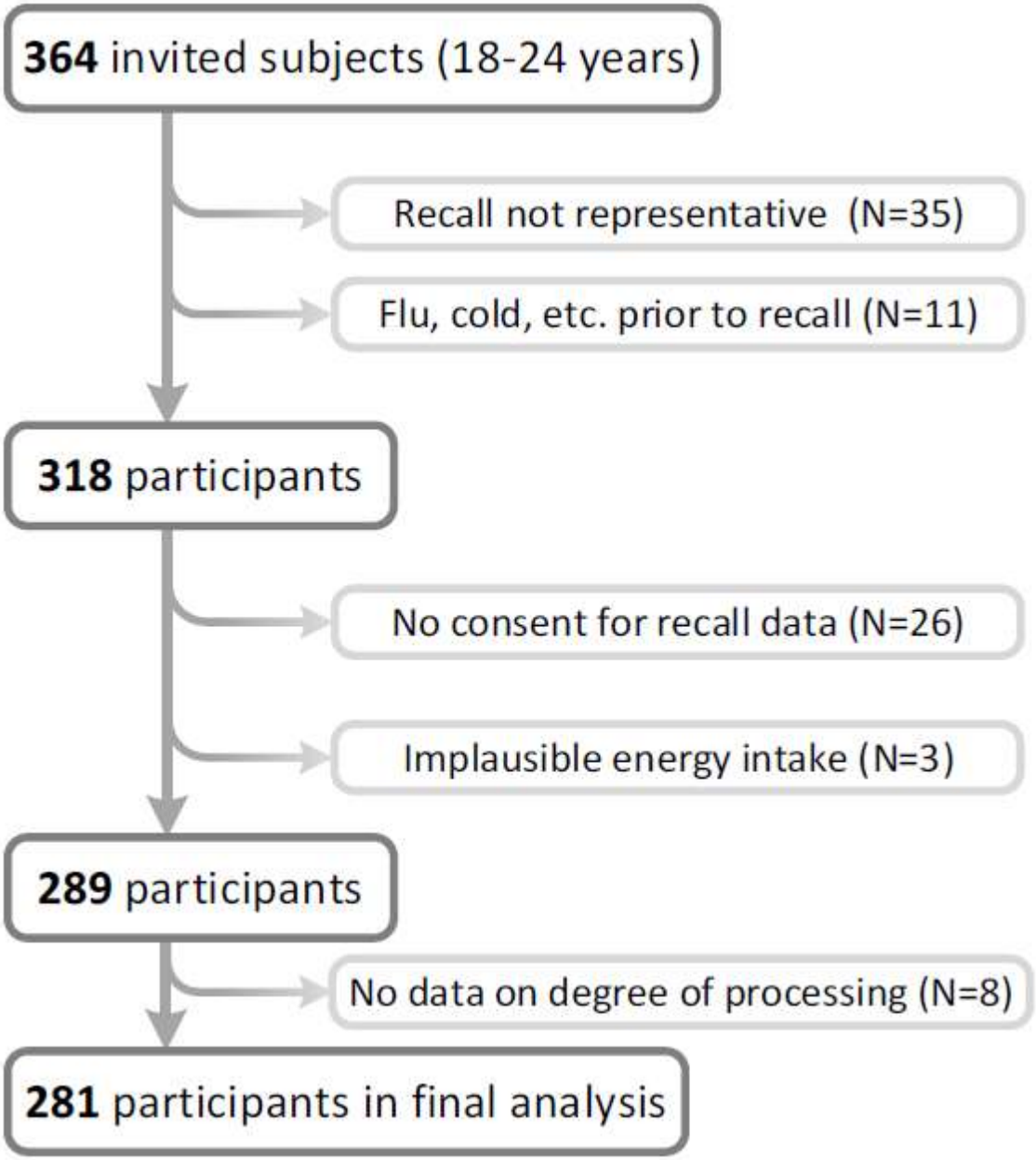

Figure 1. Flow diagram for the selection of participants included in the final analysis

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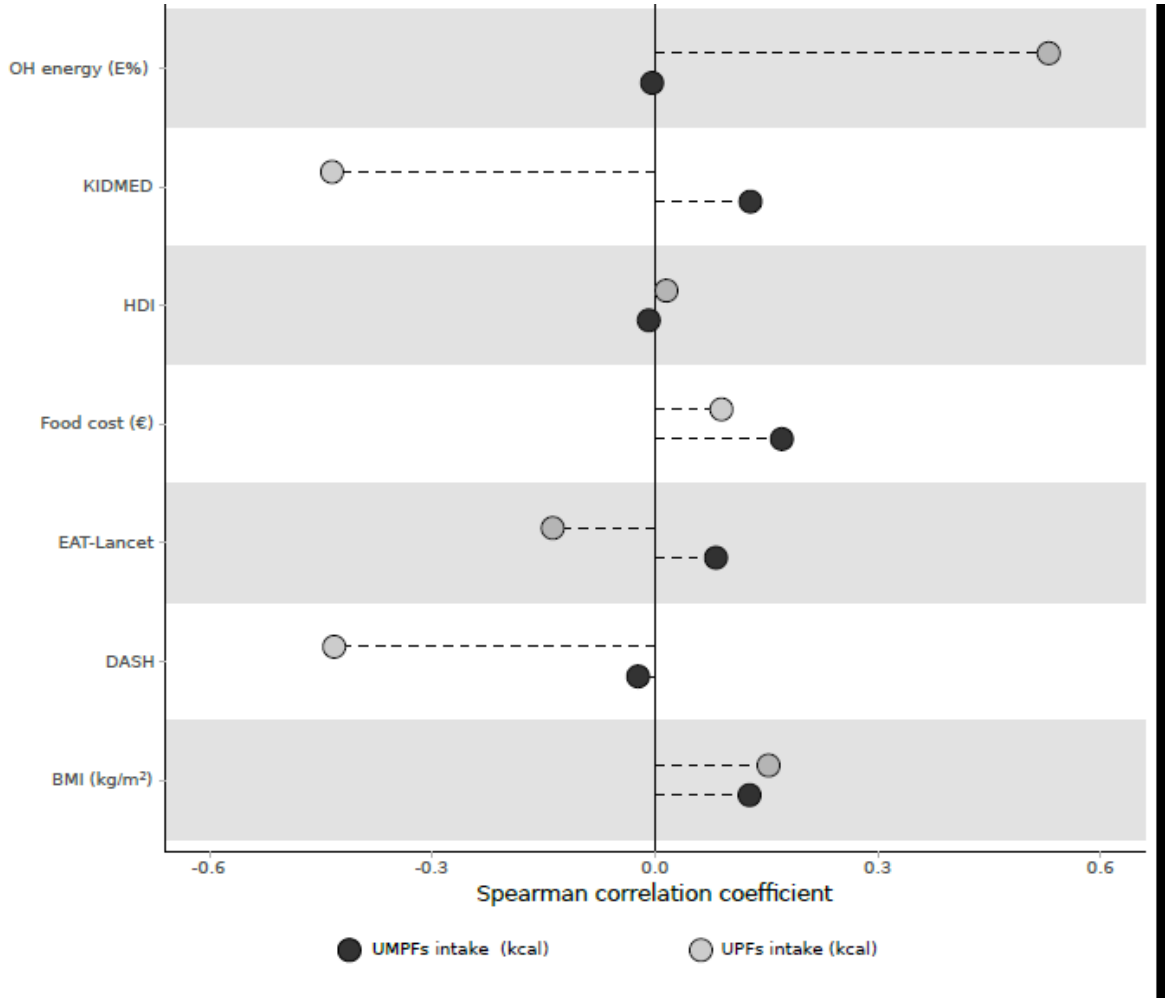

Figure 2. Correlation between main variables used in the analyses

Abbreviations: HDI: healthy diet indicator score; KIDMED: Mediterranean diet score; DASH: Dietary Approaches to Stop Hypertension score; BMI: body mass index; UPFs: ultra-processed foods; UMPFs: unprocessed or minimally processed foods; E%: contribution as percentage of energy from total calories

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Table 1. Dietary, anthropometric and socio-economic characteristics of substantial at-home and out of home eaters.

Observed Variable	**Overall (n=281)**		**Substantial at home eaters (n=103)**	**Substantial out of home eaters (n=178)**	***p-value****
	Mean (±SD)	**Range**	**Mean (±SD)**	**Mean (±SD)**	
Age (years)	19.7 (1.2)	18-23	19.7 (1.3)	19.7 (1.1)	0.812
BMI (kg/m^2)	21.3 (2.8)	16-33.8	20.9 (2.5)	21.5 (2.9)	0.124
Energy intake from UPFs (kcal)	846 (573)	0-3961.5	543.6 (354.4)	1020.9 (602.6)	<0.001
Energy intake from UMPFs (kcal)	802.9 (422.5)	0-2281.5	814.6 (415.4)	796.1 (427.6)	0.755
Mediterranean diet score (0-12)	4.4 (2)	0-11	5.80 (1.90)	3.61 (2.03)	<0.001
EAT-*Lancet* score (0-14)	1.65 (1.02)	0-5	1.81 (1.11)	1.56 (0.96)	0.084
HDI score (0-7)	3.5 (1.3)	1-6	3.6 (1.2)	3.5 (1.3)	0.540
DASH score (0-9)	3.5 (1.2)	0.5-7	4.0 (1.2)	3.2 (1.1)	<0.001
Portion size (g)	1527.6 (413.3)	144-3087	1575.6 (394.4)	1499.8 (422.4)	0.119
Food cost (€)	5.97 (2.1)	2.1-16.9	5.7 (1.8)	6.1 (2.2)	0.202

*Mann-Whitney U test for differences between at-home vs. out of home eaters; Abbreviations: SD: standard deviation; DASH: Dietary Approaches to Stop Hypertension;

HDI: Healthy diet indicator; UPFs: ultra-processed foods; UMPFs: unprocessed or minimally processed foods; BMI: Body mass index

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Table 2. Ultra-processed foods and BMI among substantial at-home and out of home eaters

	Total sample		**Substantial at-home eaters**		**Substantial out of home eaters**	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
UPFs intake (kcal)	0.16 (0.04;0.27)*	0.21 (0.08;0.34)*	-0.01 (-0.21;0.19)	0.07 (-0.13;0.27)	0.22 (0.08;0.36)*	0.24 (0.08;0.40)*
UMPFs intake (kcal)	0.12 (0.01;0.23)*	-0.03 (-0.08;0.14)	-0.16 (-0.36;0.03)	-0.24 (-0.43; -0.06)*	0.26 (0.13;0.40)*	0.18 (0.04;0.33)*

Note: Model 1 is adjusted for sex, age and energy intake. Model 2 is additionally controlled for diet quality, portion size and food costs; All values are given as: standardized linear regression coefficients (β) with the corresponding 95% confidence intervals (95%CI) unless otherwise indicated.

* Significant predictor ($p<0.05$). Abbreviations: UPFs: ultra-processed foods; UMPFs: unprocessed or minimally processed foods.

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