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Adherence to healthy and sustainable diets is not differentiated by cost, but rather source of foods among young adults in Albania

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Abstract
High cost of nutritious foods and eating out of home (OH) might be barriers to healthy and sustainable diets. We examined adherence to Dietary Approaches to Stop Hypertension (DASH), EAT–*Lancet* reference diet (EAT) and Mediterranean diet score (MDS) and the associations with dietary cost and eating OH. We evaluated cross-sectional data from single multiple-pass 24-h diet recalls from 289 young adults (18–24 years) in Tirana, Albania. Dietary cost (in Albanian Lek (ALL)) was estimated by matching food consumption data with retail prices from local fast-food chains, supermarkets, restaurants and food vendors. Poisson regression was fitted to models that included DASH, EAT and MDS as dependent variables to assess associations between healthy sustainable diet indicators and dietary cost and eating OH. Adjusted models were controlled for BMI, sex and total energy intake (kJ) using the residual method. Our findings indicate relatively poor adherence to healthy and sustainable dietary patterns among young men and women in Albania. Furthermore, better adherence to DASH, EAT or MDS was not associated with dietary cost (per 100 ALL; range incidence rate ratios (IRR): 0·97–1·00; all (un-)adjusted $P > 0·05$). Nonetheless, eating OH was related to lower adherence to DASH (IRR: 0·79; $P = 0·003$) and MDS (IRR: 0·69; $P < 0·001$). In conclusion, adherence to health and sustainable dietary patterns was poor and not differentiated by cost, but rather source of foods (i.e. OH or at home). Further research on the potential public and environmental health effects of these findings is warranted in Albania.

Key words: **24-h diet recall: Albania: Dietary cost: Dietary patterns: Sustainable diets: Young adults**

Malnutrition, in all its forms, has been increasing around the globe[1,2], particularly in low- and middle-income countries[3]. This has led to a large burden of cardiometabolic morbidity[4,5] and mortality[6], predominantly from diet-related non-communicable diseases (NCD). This unfavourable dietary shift, commonly referred to as 'the nutrition transition'[7], is marked by a departure from prudent diets, that is, high in whole-grain cereals, fruit and vegetables, legumes, nuts, and fibre, towards dietary patterns linked to the development of metabolic disorders and consequent diet-related NCD of high public health significance (i.e. CVD, type 2 diabetes and several types of cancer)[8–10].

One major lifestyle change, which has taken place over the last decades, is the growing trend of consuming food and drinks out of home (OH)[2,11–13]. The economies of scale and scope, food processing and packaging have resulted in lower prices and more convenient purchasing of food and drinks high in sugar, fat and Na, although this may vary depending on the income and development level of a country[14,15]. The consequence is that these products have become accessible and marketed especially to vulnerable groups, such as children, poorer socio-economic groups, young adults, students and ethnic minorities[16,17].

Eating OH has been associated with higher energy and fat intake and lower micronutrient intake[12], as well as higher rates of overweight and obesity[18]. In contrast, eating at home (AH) has been linked to more favourable dietary profiles[19,20]. However, research indicates that consumption of home-prepared food is not a perquisite for achieving higher dietary quality[21,22]. Despite the nuanced picture of eating OH and diet quality, consumption of foods prepared OH has been linked to elevated cardiometabolic risks[23] and conditions such as prehypertension and hypertension, particularly among young adults[24].

Abbreviations: AH, at home; ALL, Albanian Lek; DASH, Dietary Approaches to Stop Hypertension; EAT, EAT–*Lancet* reference diet; 24HR, 24-hour recall; IQR, interquartile range; MDS, Mediterranean diet score; NCD, non-communicable disease; OH, out of home.

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Nevertheless, there are established food-based dietary guidelines and patterns that serve to reduce the risk of diet-related NCD[25,26]. To illustrate, the Mediterranean diet has been associated with a lower risk of CVD among adults at risk[27]. In addition, adherence to Dietary Approaches to Stop Hypertension (DASH) has been shown to significantly lower the risk of high blood pressure[28,29]. Furthermore, Knuppel *et al.*[30] indicated that the EAT–*Lancet* reference diet score (EAT) was associated with lower odds of major health outcomes, such as ischaemic heart disease and diabetes, in adults of the European Prospective Investigation into Cancer and Nutrition (EPIC)-Oxford cohort.

Besides the global health and nutritional concerns, what we are eating and how we are producing food are also exerting huge environmental pressures[31]. Food and nutrition has emerged as one of the most promising levers to improve health and environmental sustainability[32]. Clark *et al.*[33] demonstrated that health-promoting dietary patterns often have lower environmental impacts, suggesting that dietary transitions that might lower the risk of NCD might also support the attainment of environmental sustainability targets. To address the need to feed a growing global population a healthy diet from sustainable food systems, Willett *et al.*[34] defined a universal reference diet that aims to promote both human health and environmental sustainability.

Although the nutritional composition and quality of OH dietary intake have been extensively studied, the relationships between OH eating and healthy and sustainable dietary patterns in the Balkan Peninsula remain speculative. Furthermore, dietary transition towards nutritious and more sustainable food and drink consumption necessitates economic considerations. To address these knowledge gaps, we provide a cross-sectional analysis on adherence to, and cost of diets shown to support health, reduce disease risk and promote environmental sustainability among young adults in Albania (i.e. an upper middle-income country in South-eastern Europe).

Methods

This is a secondary analysis of observational data from a cross-sectional epidemiological study conducted between October 2015 and February 2016 in Tirana, Albania[35].

Data sources

Dietary intake data were collected using a single automated multiple-pass 24-h diet recall (24HR)[36], from a cross-sectional study carried out between October 2015 and February 2016 in Tirana, Albania. The survey included 289 young adults (18–24 years), who were studying at the three largest universities in Albania (36–38 % of country's bachelor students at the time of data collection[37]), namely University of Tirana, University of Medicine Tirana and Polytechnic University of Tirana. The following eligibility criteria were used for subject inclusion: (i) enrolled in one of the aforementioned universities and (ii) studying in any of the bachelor degree programmes. The later restriction was applied with the intent to exclude students enrolled in postgraduate programmes because in Albania these programmes are often part time and these students typically work whilst studying and are thus not regularly in contact with the typical student food environment. Reported dietary intake was classified into AH and OH food and drinks, where the latter was defined as: all food items not prepared AH and obtained from fast-food companies, 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 markets. Retail prices for all items (in Albanian Lek (ALL)) were provided by local fast-food companies, supermarkets, restaurants and other food vendors. Food consumption data were matched with price data to provide estimates of dietary cost. Height (cm) and weight (kg) of the participants were measured in duplicate by trained interviewers. A third measurement was performed if the first two measurements diverged by ≥100 g for weight and ≥1 cm for height. A more detailed description of study design, study sample, definition of eating OH, validity of the recall method, as well as food composition and cost data is available in Llanaj *et al.*[35].

Sample size

For our secondary analyses on observational data, we used the formula by Signorini[38] to determine the sample size for simple Poisson regression, using the following assumptions: 90 % power ($1 - \beta$), 5 % significance level (α), intercept 0 (β_0), slope 0·1 (β_1), mean of cost 0·8 (in 1000 ALL; $\mu.X_1$), variance of cost 5 (in 1000 ALL; $\sigma^2.X_1$), mean exposure time 1 d (μ.T) and over dispersion 1(φ). Our calculations resulted in a required sample size of 202 participants.

Dietary indices and classifications

Adherence to the Mediterranean diet score (MDS) was computed according to the index developed by Serra-Majem *et al.*[39], for subjects aged up to 24 years. The index ranges from 0 to 12, based on a sixteen-question test and is founded on principles sustaining Mediterranean dietary patterns 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), and those with a positive aspect +1 (e.g. use of olive oil).

In addition, the DASH index, previously used by Mellen *et al.*[40], was calculated for our sample of young Albanian women and men. This version of the DASH index is an entirely nutrient-based DASH diet score, based on target nutrient values from the DASH diet used in two clinical trials[41,42]. Individuals who meet the goal for each component receive 1 point, those who meet an intermediate goal, defined as the midpoint between the DASH diet goal and the nutrient content of the DASH control diet[41], receive 0·5 point and those who meet neither goal received 0 points. A total score was generated by summing all nutrient components, resulting in a minimum of 0 and a maximum of 9 points. Intake of energy-yielding nutrients was calculated as a percentage of total energy intake and intake for other nutrients was adjusted for quantity (g or mg) per 4184 kJ (1000 kcal).

Dietary intake data from our sample were also compared with the EAT–*Lancet* reference diet for healthy diets from sustainable food systems[34]. An EAT score (0–14 points) was calculated based on the adherence to fourteen key dietary recommendations, as described in Knuppel *et al.*[30]. EAT ranges correspond to the average energy needs (10 460 kJ/d (2500 kcal/d)) of a 30-year-old woman weighing 60 kg and whose physical activity level is between moderate and high (1·7–2·0)[34]. Hence, calculations for estimated food group intakes were standardised for an energy intake of 10 460 kJ/d (2500 kcal/d).

Participants were classified as 'substantial AH eaters' if ≤20 % of their total dietary energy intake came from foods and drinks prepared OH and as 'substantial OH eaters' if this percentage was higher than 20 %.

Dietary adherence levels

A dichotomous outcome was created for DASH, with individuals meeting approximately half of the DASH targets (score ≥ 4·5 points) considered 'DASH accordant', while others 'DASH non-accordant'[40]. EAT and MDS adherence levels where determined by dividing the score distributions into three categories: (1) low adherence (<25th percentile), (2) moderate adherence (between 25th and 75th percentiles) and (3) high adherence (>75th percentile).

Statistical analysis

Poisson regression was fit to models that included DASH, EAT and MDS as dependent variables, given their discrete, bounded nature and equidispersion of the distributions, to assess associations between healthy sustainable diet indicators and dietary cost and OH eating. Adjusted models controlled for BMI, sex and total energy intake (kJ) using the residual method[43]. To examine any differences in the association between dietary indices and cost by level of eating OH, we tested interaction terms between dietary cost and OH as a binary variable (i.e. 0 for ≤20 % and 1 for >20 % total energy (kJ/d)). Moreover, for further exploratory analyses, ordinary least-squares regression was fit to models that included BMI as the dependent variable and dietary indices as the predictors.

Numerical values were accompanied by their 95 % CI or interquartile range (IQR) where applicable and Student's *t* test or the Mann–Whitney *U* test was used to test for differences between sexes. Food intake data were processed using the Lucille Food Intake software. Data management and statistical analyses were performed with Stata 14.2 and R Statistics 3.14. A two-sided significance level of $P < 0·05$ was applied for all analyses.

Ethics

All subjects gave their written informed consent before 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.

Results

Sample characteristics

24HR data were obtained for 289 young adults (87 % women; age range: 18–24 years; Table 1). DASH, EAT and MDS were (median (IQR)) 3·5 (IQR 2·5, 4), 2 (IQR 1, 2) and 4 (IQR 3, 6), respectively. Furthermore, 237 (82 %) subjects were considered substantial OH eaters (i.e. >20 % kJ/d). Moreover, mean (SD) dietary energy intake was 10 088 (SD 2506) kJ/d, dietary cost was 806 (SD 284) ALL/d and BMI was 21·4 (SD 3·2) kg/m^2. Adherence to all three dietary patterns was poor, in particular, for intakes of vegetables, fruits, sweeteners and animal-source foods (Fig. 1).

Our findings indicate non-significant differences in most (micro) nutrient intakes (except carbohydrates and Na) between women and men (Table 1). However, height (cm), weight (kg), total energy intake (kJ) from OH consumption and BMI were significantly different between women and men, with the latter having higher values. Anthropometric measurements were not significantly different among substantial AH and OH eaters ($P > 0·05$; results available on request). Dietary intakes of total fats (%E), SFA, sugar (both %E and g/d), cholesterol (both mg/4184 kJ and g/d) and Na (both mg/4184 kJ and g/d) were higher than the reference ranges for both sexes. In contrast, dietary intakes of carbohydrates, dietary fibres (both g/4184 kJ and %E), Mg and K (both mg/4184 kJ and g/d) were significantly lower than the reference ranges for both sexes.

When comparing substantial OH and AH consumers, there was a significant positive association ($P < 0·05$) between adhering to health-promoting dietary patterns and being a substantial AH eater, for both DASH ((non)-accordant) and MDS (low, moderate and high; Table 2).

Associations between dietary indices, cost, out of home eating and BMI

DASH, EAT and MDS were consistently neutrally associated with dietary cost (in ALL) among young men and women (range incidence rate ratios: 0·97–1·00; all $P > 0·05$; Table 3; Fig. 2). Unadjusted models indicated similar results and are therefore not shown. Nevertheless, eating OH was related to lower adherence to DASH (incidence rate ratio: 0·79; $P = 0·003$) and MDS (incidence rate ratio: 0·69; $P < 0·001$), but non-significant for EAT ($P > 0·05$). When comparing dietary cost of adherence levels, stratified by substantial AH *v.* OH eaters, there was no statistical differences between those eating more OH and those eating more AH (Fig. 2). Furthermore, the interaction terms between dietary indices and OH were also non-significant (all $P > 0·05$).

Further exploratory analyses indicated that for each one-point increase in healthy and sustainable diet scores, BMI changed by between −0·3 and 0·2 kg/m^2 (Table 4). However, only the unadjusted association between BMI and MDS was significant (β: 0·2 (SE 0·1); $P = 0·028$).

Discussion

Our study reports that adherence to healthy and sustainable dietary patterns is suboptimal among young adults in Albania. However, our findings indicate that a transition to more human and environmental health-promoting diets is not constrained by cost, but rather by the level of OH eating. In parallel to priority action areas set by the National Program on Prevention and

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Table 1. Anthropometric measurements and dietary intake, cost and indices from our sample of young adults in Albania§
(Mean values and 95 % confidence intervals; median values and interquartile ranges (IQR))

	Total (*n* 289)			Females (*n* 252)‖			Males (*n* 37)			Reference range		
		95 % CI			95 % CI			95 % CI				
Variable	Mean	Lower	Upper	Mean	Lower	Upper	Mean	Lower	Upper	Range	Source	*P*†
Height (cm)	165·6	164·6	166·6	164·2	163·4	165·0	176·7	176·0	177·3	NA		***
Weight (kg)	58·9	57·7	60·1	56·9	56·0	57·9	74·0	73·1	75·0	NA		***
Total energy (kJ)	10 089·7	9799·6	10 379·7	9762·9	9469·6	10 056·2	12 385·1	11 627·3	13 143·2	NA		***
Energy OH (kJ)	4891·1	4552·2	5230·0	4517·5	4184·0	4851·0	7332·9	6367·2	8298·5	NA		***
BMI (kg/m^2)	21·45	21·08	21·8	21·1	20·8	21·5	23·8	23·4	24·1	20–25	[25]	***
Total fats (%E)	34·9§	34·0	35·8	34·8§	33·8	35·7	35·8§	33·9	37·7	15–30	[25]	NS
SFA (%E)	11·9§	11·5	12·4	11·8§	11·3	12·3	13·1§	11·9	14·4	0–10	[25,34]	NS
PUFA (%E)	4·2	4·0	4·3	4·1	4·0	4·3	4·2	3·9	4·5	3–7	[25]	NS
Protein (%E)	14·2	13·7	14·7	14·1	13·5	14·6	15·3	14·1	16·5	10–15	[25]	NS
Carbohydrates (%E)	51·6§	50·5	52·8	52·1§	50·8	53·3	48·4§	45·9	50·9	55–75	[25]	NS
Sugar (%E)	18·2§	17·2	19·2	18·7§	17·7	19·8	14·6§	11·9	17·2	≤10; ≤8·2	[25,34]	**
Sugar (g)	108·9§	102·5	115·3	110·2§	103·6	116·9	110·6§	89·3	131·8	≤31	[34]	NS
Dietary fibres (g/4184 kJ)	12·9§	12·3	13·6	13·1§	12·4	13·8	11·8§	10·1	13·4	≥14·8	[40]	*
Dietary fibres (%E)	2·1§	1·8	2·3	2·1§	1·9	2·2	2·1§	1·8	2·4	≥7	[34]	NS
Mg (mg/4184 kJ)	102·0§	98·9	105·1	102·6§	99·2	106·0	97·6§	91·1	104·0	≥238	[40]	NS
Ca (mg/4184 kJ)	755·8	706·9	804·8	755·0	701·8	808·1	762·1	634·0	890·3	≥590	[40]	NS
K (mg/4184 kJ)	1196·6§	1156·6	1236·5	1206·9§	1163·9	1249·8	1124·1§	1012·6	1235·5	≥2238	[40]	NS
K (mg)	2879·2§	2756·9	3001·5	2853·6§	2727·0	2980·1	3277·3§	2928·6	3626·1	≥4100	[34]	NS
Cholesterol (mg/4184 kJ)	95·5§	89·2	101·8	94·0§	87·1	100·9	106·0§	90·2	121·8	≤71·4	[40]	NS
Cholesterol (mg)	232·2§	215·3	249·1	222·8§	205·3	240·3	313·0§	263·2	362·8	≤125·2	[34]	***
Na (mg/4184 kJ)	963·9	914·7	1013·1	944·6	893·1	996·1	1099·6	942·0	1257·1	≤1143	[40]	NS
Na (mg)	2343·8§	2205·9	2481·7	2258·5§	2118·0	2398·9	3180·1§	2773·3	3586·9	≤2000	[44]	***
Cost (ALL)	835·6	763·5	907·7	796·6	762·3	830·9	874·6	764·7	984·5	NA		NS
DASH score										0–9	[40]	NS‡
Median	3·5			3·5			3·0					
IQR	2·5, 4·0			2·5, 4·0			2·5, 4·0					
EAT–*Lancet* score										0–14	[30]	NS‡
Median	1·0			1·0			1·0					
IQR	1·0, 2·0			1·0, 2·0			1·0, 2·0					
Mediterranean diet score										0–12	[39]	NS‡
Median	4·0			5·0			4·0					
IQR	3·0, 6·0			3·0, 6·0			3·0, 5·0					

NA, not applicable; OH, out of home; %E, percentage of total energy intake; ALL, Albanian Lek; DASH, Dietary Approaches to Stop Hypertension.
* $P < 0·05$, ** $P < 0·01$, *** $P < 0·001$.
† *P* value for difference between sexes by Student's *t* test (unless otherwise indicated).
‡ Mann -Whitney *U* test (difference between sexes).
§ Significantly different nutrient intake as compared with the reference range.
‖ Proportion of female students at study universities varied from 86 to 90 % (http://www.instat.gov.al/media/4616/tab4.xlsx).

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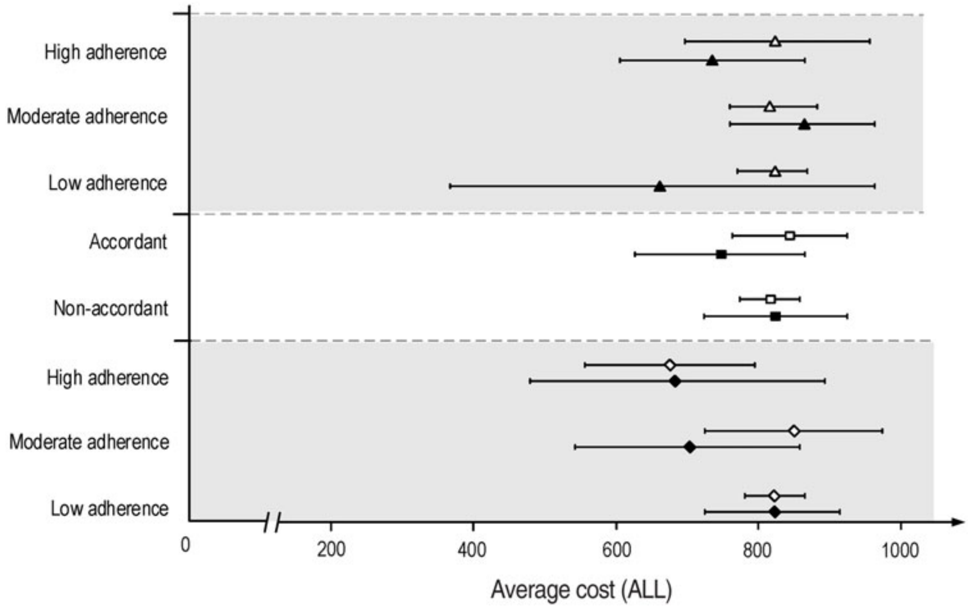

Fig. 1. Adherence to EAT–*Lancet*, Dietary Approaches to Stop Hypertension (DASH) and Mediterranean diet reference intake values among young adults in Albania. ALL, Albanian Lek (1 ALL approximately 0·0081 Euro). ■, DASH diet; ◆, EAT–*Lancet* reference diet; ▲, Mediterranean diet; ◆■▲, substantial at home eaters; ◇□△, substantial out of home eaters.

Control of NCD in Albania (2016–2020) and National Action Plan for Food and Nutrition (2013–2020), our study advocates for multi-sectoral food and nutrition policies and integrated programmes[45] (e.g. regulation of university food environments, such as student restaurants and canteens) targeting unhealthy OH eating and championing nutritious and sustainable diets for students in Tirana.

Young adults around the globe play a critical role in the discourse on environmental sustainability, by encouraging social change and sparking political action. Nevertheless, considering the detrimental planetary health impact of current food systems[46], a large majority of the EAT–*Lancet* reference values, in particular vegetable, fruit, sweetener and limited animal-source food consumption, were not attained by young Albanian men and women. At present, recommendations on 'Healthy Nutrition in Albania' (i.e. national food-based dietary guideline[47]) fail to include sustainability criteria, although there is mounting evidence linking overconsumption of, in particular, red and ultra-processed meat products with detrimental human and environmental health outcomes[33,48,49]. Furthermore, our study participants' dietary intakes indicate 'non-accordance' to DASH guidelines, which is advocated to promote cardiovascular health[28], and low/moderate adherence to MDS, similar to previous studies in the Mediterranean basin[50,51]. Thus, our findings offer novel insights into contemporary food and drink consumption among Albanian university students, and key dietary recommendations which might require special attention during nutrition/public health education, such as the importance of fibre, fruit, vegetable and whole-grain intake and the substitution of saturated fats by MUFA/PUFA sources.

Our findings that adherence to DASH and MDS was differentiated by OH eating are supported by previous research linking OH eating to increased energy intake[52], decreased intake of fruit and vegetables[53] and lower intakes of micronutrients[12]. Furthermore, Fleischhacker *et al.*[54] reported that living in an area with a higher access to fast food (e.g. student areas in Tirana) was related to increased OH consumption. Our lack of association between EAT and OH eating might be explained by the absence of lower bound intake values (i.e. 0 g/d) for various dietary recommendations leading to positively scoring non-consumption[55]. Nonetheless, dietary patterns of young adults in our survey were poor, regardless of predominantly AH or OH eating[35]. We argue that these findings are not only a consequence of inappropriate quantity and quality of food and drinks in the Albanian diet[12], but fundamentally a consequence of a global challenge: food systems that fail to provide everyone with healthy, safe, affordable and sustainable diets[56]. The economic, social and environmental costs of further inaction will hinder the growth and development of individuals and societies for decades to come[45,57]. As the *Lancet* Series on the 'Double Burden of Malnutrition' shows, the complex interconnected biological and social pathways of all forms of malnutrition are difficult to disrupt through siloed interventions and require societal shifts that can be scaled up and sustained over decades[1,58]. Further studies are needed to determine the food system determinants as well as other social drivers (e.g. food deserts, employment conditions) of poor dietary intake in Albania.

In contrast to previous research on the dietary cost of DASH[59], EAT[60] and MDS[61], our results indicate that higher adherence to these dietary patterns was not associated with increased food and drink expenditure. Nevertheless, our coefficients might be attenuated due to the overall poor adherence to healthy and sustainable dietary patterns among university students in Albania. Thus, suboptimal diets might still be explained

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Table 2. Adherence to the Dietary Approaches to Stop Hypertension (DASH) index, EAT–*Lancet* reference diet (EAT) and Mediterranean diet score (MDS), by at-home (AH) or out-of-home (OH) eating* (Numbers and percentages)

	AH eaters* (*n* 52)				OH eaters† (*n* 237)				Total (*n* 289)			
	Females (*n* 50)		Males (*n* 2)		Females (*n* 202)		Males (*n* 35)		Females (*n* 252)		Males (*n* 37)	
Dietary pattern	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
DASH accordant‡	21	42	1	50	41	20·3	6	17·1	62	24·6	7	18·9
DASH non-accordant	29	58	1	50	161	79·7	29	82·9	190	75·4	30	81·1
Low adherence to EAT	5	10	1	50	23	11·3	4	11·4	28	11·1	5	13·5
Moderate adherence to EAT	32	64	1	50	143	70·8	24	68·6	175	69·4	25	67·6
High adherence to EAT	13	6·4	0	0	36	17·8	7	20·0	49	19·4	7	18·9
Low adherence to MDS	3	6	0	0	42	20·8	9	25·7	45	17·9	9	24·3
Moderate adherence to MDS	27	54	2	100	130	64·4	23	65·7	157	62·3	25	67·6
High adherence to MDS	20	40	0	0	30	14·9	3	8·6	50	19·8	3	8·1

* Subjects with mean daily intake ≤20 % of total energy coming from foods/drinks prepared OH.
† Subjects with mean daily intake >20 % of total energy coming from foods/drinks prepared OH.
‡ DASH adherence ≥4·5 points is classified as 'accordant'.

by economic constraints, since food prices influence food choices and constitute a major barrier to dietary change[62].

The first limitation of our observational analysis is the single 24HR, obtained from a relatively small sample of young adults in Tirana. Although 24HR provide a higher degree of accuracy for assessing food and nutrient intake relative to FFQ, such dietary assessment methods are prone to measurement error due to respondent memory lapses and social desirability/approval of specific food and drinks[63]. Moreover, 24HR are appropriate to estimate population average dietary intakes, but do not account for intra-person variability[64] and thus estimation of usual dietary intake[65]. Second, due to the cross-sectional nature, our study was unable to assess relationships between DASH, EAT and MDS and long-term health outcome and/or environmental impacts in Albania. At the time of the research, the EAT–*Lancet* dietary pattern was not yet promoted (or adopted in Albanian food guides), therefore necessitating caution when interpretation our findings. Third, the population under investigation was composed mainly of female university students, which might hamper generalisability. However, this high representation is reflective of the sex composition of the three public universities the participants were recruited from, which varied between 86 and 90 %[66]. Fourth, our study was unable to provide more detailed data on the (perceived) socio-economic status of university students, a knowledge gap to be addressed by future research (i.e. potential missing confounding, as previous studies have reported that wealth status influences food choice and subsequent diet quality[67]). Nonetheless, we argue that most Albanian students are financially constrained (although not captured by our study due to unavailable data), as supported by recent mass student protests due to hiked university fees[68]. Last, we were unable to describe, in detail, the student food environment (fast- and street food vendors clustered around the faculties or their residence areas[69]). Future public health research in Albania must aim to capture students' access to healthy OH options, the degree of processing of foods and characterisation of university housing, such as kitchen spaces, in order to better understand barriers for the adoption of healthy and sustainable dietary patterns among youth in Albania.

Our study highlights the need to establish and integrate young adulthood nutrition and health in, at present absent[70], (sub)-national surveillance and monitoring systems (e.g. national food intake survey). Furthermore, given the known complexity of dietary behaviours and the wide range of external influences on dietary patterns during this life period, championing sustainable diets in Albania will require pro-active collaboration between a wide range of actors and policies throughout the food system, including the active engagement of university students. At present, an unprecedented opportunity for action exists across South-eastern Europe, within the frameworks of the United Nations Decade of Action on Nutrition (2016–2025) and the 2030 Agenda for Sustainable Development. Thus, further prospective epidemiological studies on the potential public and environmental health effects of our findings (and potential dietary shifts) are warranted in Albania and the Western Balkans.

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Table 3. Associations between healthy and sustainable diet indicators, dietary cost and out of home (OH) eating among young adults in Albania (*n* 289)* (*β*-Coefficients and standard errors)

	DASH (0–9 points)			EAT (0–14 points)			MDS (0–12 points)		
Independent variable	*β*	SE	*P*	*β*	SE	*P*	*β*	SE	*P*
Cost (per 100 ALL)	0	0·01	0·77	–0·02	0·02	0·33	–0·01	0·01	0·24
OH eating	–0·23	0·08	0·003	–0·12	0·12	0·29	–0·38	0·07	<0·001
Cost × OH eating	0	0·03	0·80	0·07	0·05	0·15	0·01	0·02	0·83

DASH, Dietary Approaches to Stop Hypertension; EAT, EAT–*Lancet* diet score; MDS, Mediterranean diet score; *β*, Poisson regression *β*-coefficient; ALL, Albanian Lek.
* Multivariable-adjusted models include BMI, sex and 'total energy intake (kJ)' as confounders.

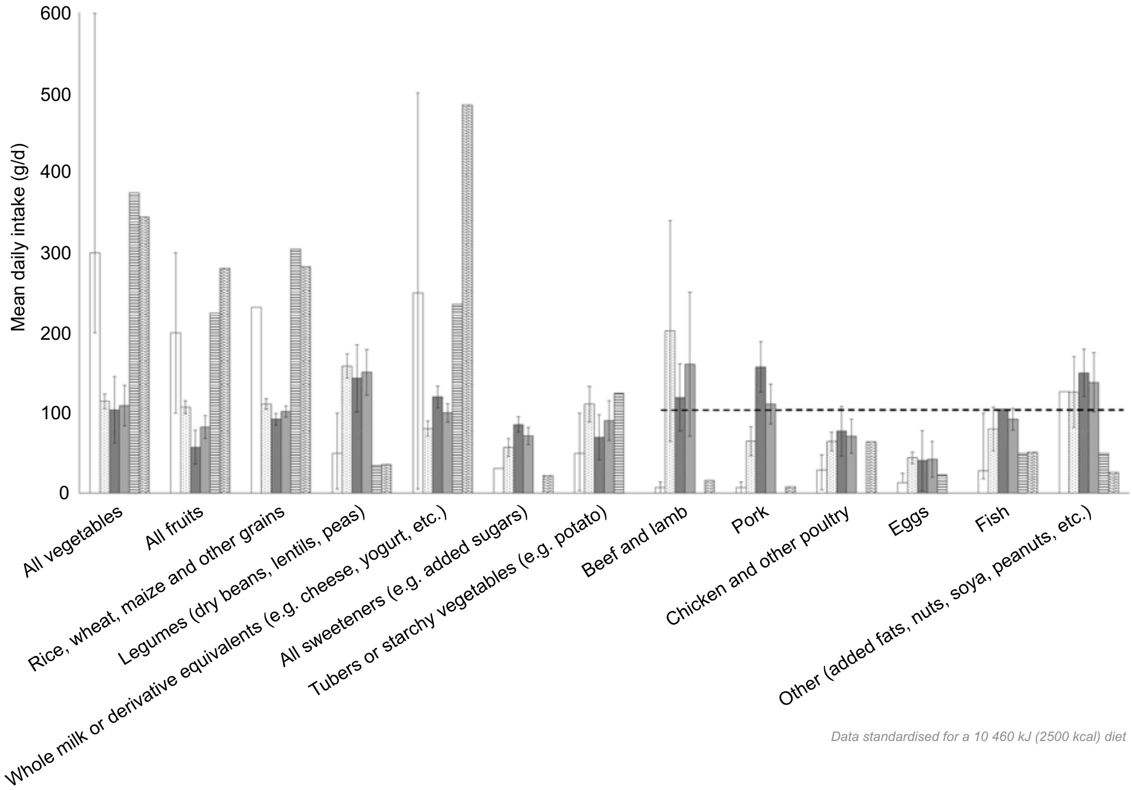

Fig. 2. Level of adherence to healthy and sustainable dietary patterns and average dietary cost among young adults in Albania. ☐, EAT–*Lancet*; ▨, substantial at home eaters; ■, substantial out of home eaters; ■, overall diet; ▤, Mediterranean diet; ▧, Dietary Approaches to Stop Hypertension; - - - -, recommendation based on average content of the Mediterranean diet for meat and meat products (i.e. lean meat/poultry/fish/eggs/nuts and seeds/legumes grouped together in dietary guidelines, not separately).

Table 4. Associations between healthy and sustainable diet indicators and BMI among young adults in Albania (*n* 289)
(*β*-Coefficients and standard errors)

	BMI (kg/m²)					
	Unadjusted model			Adjusted model*		
Independent variable	*β*	SE	*P*	*β*	SE	*P*
DASH (0–9 points)	0·1	0·2	0·53	0·2	0·2	0·27
EAT (0–14 points)	–0·3	0·2	0·07	–0·3	0·2	0·13
MDS (0–12 points)	0·2	0·1	0·03	0·2	0·1	0·05

β, Ordinary least-squares *β*-coefficient; DASH, Dietary Approaches to Stop Hypertension; EAT, EAT–*Lancet* diet score; MDS, Mediterranean diet score.
* Adjusted models include sex and 'total energy intake (kJ)' as confounders.

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The authors' contributions were as follows: E. L. and G. H.-C. conceptualised the research; E. L. conducted and coordinated the research; E. L. lead the study design and data collection; E. L. and G. H.-C. developed the first draft and revised the manuscript; E. L. and G. H.-C. analysed data. Both authors read and approved the final manuscript.

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