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Alcohol consumption among students and its relationship with nutritional intake: a cross-sectional study

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Abstract

Objective: Excessive alcohol consumption during reproductive years may impact the integrity of developing eggs and sperm, potentially affecting the life-long health of future children. Inadequate diets could aggravate these preconception effects of alcohol. The aim of the present study was to assess the prevalence of excessive alcohol consumption and explore whether weekly alcohol intake is associated with energy and nutrient intake and adequacy of micronutrient intake among students.
Design: Cross-sectional survey using a validated and reproducibility-tested FFQ.
Setting: University of Agder, Norway, in 2018.
Participants: 622 students (71 % female).
Results: More than 80 % reported having consumed alcoholic beverages the past 4 weeks. One-third of men and 13 % of women exceeded the upper recommended limit of 14 UK alcohol units/week. An inverse association between increasing alcohol intake and energy-adjusted micronutrient intake was evident for thiamine, phosphate, Fe, Zn and Se in men, and for vitamin A, β-carotene, vitamin E and C, thiamine, vitamin B_6, folate, P, Mg, K, Fe, Zn and Cu in women. A substantial proportion had vitamin D, folate, Fe and I intakes below average requirement regardless of alcohol consumption level. The combination of prevalent alcohol use, decreasing micronutrient density of diet across alcohol consumption level and a high probability of micronutrient inadequacy indicate reason for concern in a preconception public health perspective.
Conclusions: Our findings call for investigations into young adults' knowledge, reflections and beliefs regarding diet and alcohol use to understand how these behaviours could be improved ahead of parenthood.

Keywords
Student diet
Alcohol consumption
Micronutrients
StudentKost
Preconception

Alcohol use has a complex relationship with health and causes substantial health loss across the lifespan[1]. According to the WHO, the harmful use of alcohol is a causal factor in more than 200 disease conditions, including mental and behavioural disorders, other non-communicable conditions and injuries[2]. Excessive alcohol consumption causes death and disability relatively early in life, and findings from the Global Burden of Disease project showed that among the population aged 15–49 years, alcohol was the leading risk factor for death in 2016, accounting for 3·8 % (95 % CI 3·2, 4·3) for women and 12·2 % (10·8, 13·6) for men in 2016[1]. Alcohol may also affect nutritional status because its metabolism prevents the body from properly digesting, absorbing and using many nutrients[3].

A public health-related dimension of alcohol use confined to reproductive age is the adverse effects of alcohol on developing egg and sperm, potentially affecting the health and development of not-yet-conceived offspring. Both egg and sperm are nutritionally and toxicologically vulnerable to their surrounding environment[4,5]. There is now compelling evidence that alcohol exposure may epigenetically affect developing egg and sperm and induce stable and irreversible gene expression patterns that may be carried forward in the offspring[6]. Alcohol also contributes to energy intake and may influence the risk of overweight and obesity over time[7].

Puberty initiates a period of growth and maturation of musculoskeletal, neurodevelopmental, endocrine, metabolic, immune, cardiometabolic and reproductive systems

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that extend into young adulthood[8]. During this period, women build nutritional capacity for childbearing, while men build biological capital for the general demands of life[8,9]. A poor or suboptimal diet during adolescence and young adulthood may detract from reproductive fitness, with individual and cross-generational health consequences[8].

Students represent a group of young adults typically in the transition from living with their family to establishing a life on their own. Many will engage in intimate relationships during this life stage and some will become parents during their university years. From this perspective, the aim of the present study was to assess the prevalence of excessive alcohol consumption in a sample of students and explore whether weekly level of alcohol intake is associated with energy and nutrient intake and adequacy of micronutrient intake.

Methods

Study design

The analyses for this paper are based on dietary data from the cross-sectional survey StudentKost[10]. The overall aim of StudentKost was to assess students' diet in relation to official dietary guidelines. The data collection was carried out from the end of October until early December 2018 and all students enrolled at the University of Agder, Kristiansand, Norway, aged 18–40 years were eligible for participation. Students were approached through a short film that was repeatedly shown at boards around the university and through invitations distributed in social media. We also distributed flyers in university classrooms and smaller group study rooms. Due to limited response rate from these approaches, we obtained permission from the university administration to send invitations via the students' institutional email. The email invitation included a link to the study webpage where participants could read about the study before consenting by completing a web-based questionnaire. A web-based tool for conducting questionnaire-based programmes, SurveyXact, was used to conduct the survey[11].

The questionnaire

The questionnaire consisted of general information about the participants (5 items), a validated and reproducibility-tested FFQ (152 items)[12], questions about eating habits (12 items), motivational factors and barriers to healthy eating (26 items), physical activity and sedentary behaviour (8 items) and tobacco use (6 items).

Weekly consumption of alcoholic beverages was assessed with six questions regarding type and frequency of use on weekdays, and the same questions about use during weekends. The frequency of intake of the following types of beverages with predefined item size was asked for non-alcoholic beer (0·5 l), beer (0·5 l), cider or alcopops (0·5 l), wine (1 glass) and spirits (1 drink). Frequency of use during weekdays was reported as 'do not drink', 1–3 items/month, 1–3 items/week, 4–6 items/week, 1 item/d, 2–3 items/d and >3 items/d. Frequency of use during weekends was reported as 'do not drink', 1–3 items/month, 1–2 items/weekend, 3–4 items/weekend, 5–6 items/weekend and >6 items/weekend. Frequency of intake for each alcoholic beverage was averaged across the reported range and recoded into frequency per month (e.g., 1–2 items/weekend averaged 1·5 item/weekend × 4 weekends/month). Frequency of intake of the predefined units per month was further recoded into frequency of intake per day. The size of the item and its alcohol content according to the food composition table were used to compute grams of alcohol per day that was further recoded into units of alcohol per week.

For descriptive purposes, we combined the various smoking variables into one smoking variable (comprising cigarettes, cigars, pipe, etc.), but kept snuff as a separate tobacco variable. We then dichotomised these variables into never/seldom *v.* sometimes/daily. The food frequency part of the questionnaire was composed of different categories, for example, beverages, bread and grain products, spreads, dairy products, main dishes, side dishes, fruit and vegetables, desserts, cakes, sweets and snacks. The response alternatives given in the survey ranged from never eating the specific food item to eating it every day. There were in total 5–7 different frequency categories depending on the nature of the question. Every product had a definition of how much one portion would equal. Participants were asked to report diet according to their consumption the last 4 weeks.

Participants had to answer every question to complete the questionnaire, with self-reported height and weight being the only voluntary information. Satisfactory test–retest reproducibility and fair relative validity of the FFQ assessed against a 7-day food record have been documented[10]. Median test–retest Spearman's r correlations for energy and nutrients was $r = 0{\cdot}85$, ranging from $r = 0{\cdot}56$ for vitamin D to $r = 0{\cdot}93$ for Ca. Median Spearman's r correlations with 7-day food record was $r = 0{\cdot}59$, ranging from $< 0{\cdot}005$ for saturated fat to $r = 0{\cdot}78$ for folate. For alcohol intake, the respective correlations were $r = 0{\cdot}83$ for test–retest reproducibility and $r = 0{\cdot}71$ for relative validity.

We used Python[13] and FoodCalc[14] to calculate energy and nutrient intake. Python calculates the quantity of individual food items, while FoodCalc estimates the nutrient intake by pairing the registered quantity of each food item with its corresponding nutrient content from the relevant food item code given in the Norwegian Food Composition Table[15].

Definition of units of alcohol and categorisation of levels of alcohol consumption

The definition of what constitutes a unit of alcoholic drinks varies across countries from approximately 8–12 g[16]. We

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applied the UK definition of one alcohol unit equalling 8 g of alcohol by weight to be able to compare findings with studies presenting outcomes based on this unit definition[17].

The UK cut-off for keeping health risks from alcohol to a low level is defined as 14 alcohol units/week[18–19]. We categorised participants into three categories according to the level of weekly alcohol intake: zero alcohol consumption (abstaining from alcohol), ≤ 14 units/week (moderate alcohol consumption) and > 14 units/week (excessive alcohol consumption). We also assessed the proportion of participants with excessive alcohol consumption according to the 2012 Nordic Nutrition Recommendations definition: the contribution of alcohol to total energy intake of more than 5 %[20].

Statistical analysis

We used IBM SPSS 25.0[21] for data analysis. As women and men differ in energy and nutrient requirements, all analyses were carried out stratified by gender. We compared participant characteristics (age, education, weight, height, BMI, smoke and snuff), food and beverage consumption, and nutrient intakes (absolute and energy-adjusted intake) across the previously described three categories of increasing alcohol consumption. We also assessed the proportion of participants with micronutrient intakes below the average requirement (AR) for age and gender across alcohol consumption level[20]. The AR for a specific micronutrient is estimated to cover the requirement for approximately half of an age- and gender-specific population[20]. Intake below this value for a specific micronutrient therefore implies a relatively high probability of inadequate intake[20].

For comparisons across levels of alcohol intake, we used one-way ANOVA for continuous variables, Kruskal–Wallis test for food variables and χ^2 test for categorical variables. Results are presented as mean (SD), median (interquartile range) or number with proportions (%). Significance level was set to $P \leq 0{\cdot}05$.

We estimated associations between level of alcohol consumption and nutrient intake in linear regression models both in absolute terms and energy-adjusted (nutrient intake/MJ). We computed a continuous variable of weekly alcohol intake in two-unit increments (16 g of alcohol), ranging from 0 until 40 units of alcohol (306 g of alcohol) or more per week and modelled energy-adjusted nutrient intake (nutrient intake/MJ) as a function of weekly alcohol intake in linear regression analyses. We applied log-transformed energy and nutrient variables to approach normality and improve assumptions in the linear regression models. Estimates are presented as beta (β), SE, standardised beta and 95 % CI. In the interest of comprehension, we exponentiated the coefficient, subtracted one from this number and multiplied by 100 (exp(coefficient)–1)) × 100) to yield the percentage increase or decrease in the response variable (energy and nutrient intake) for every two-unit increase in the independent variable (weekly alcohol consumption).

Results

Approximately 13 000 students were approached with the invitation to participate in the survey. Out of 743 participants who responded and answered at least one or more questions, 617 completed the entire survey and were included in the analyses. We included five additional participants who had completed the food frequency part of the questionnaire and could be included in the calculations of alcohol consumption and nutrient intake. The final sample for the present analyses was therefore 622 participants of which five lacked information on one or more background variables (4·8 % of those potentially eligible for participation). Women constituted 71·4 % of the sample. Mean age was 23·4 and 23·6 years for female and male students, respectively. One in two were first-year students (*n* 299, 48·1 %).

Approximately 17 % of men and 16 % of women reported no intake of alcohol the previous 4 weeks. Alcohol intake varied from 0 to 493 g/week for men and 0 to 387 g/week for women. Applying the UK definition of 8 g of alcohol/unit and the recommended limitation of alcohol intake to a maximum of 14 units/week for both genders, 33 % of male and 13 % of female students had excessive alcohol intake. These proportions were almost identical when the Nordic Nutrition Recommendations definition of excessive alcohol intake was used (33 % of men and 15 % of women). The Norwegian definition of one alcohol unit equals 13 g of alcohol by weight. Applying the Norwegian definition of 13 g alcohol/unit with the upper limit of 14 units/week for both genders (equal to 182 g alcohol/week), only 4 % of women and 12 % of men were categorised as having excessive alcohol intake.

Participant age, height, weight, BMI, education and tobacco use across categories of increasing alcohol intake are presented in Table 1. The only covariance with alcohol intake was a substantially higher prevalence of obesity among women with excessive alcohol intake *v.* alcohol abstainers and those with alcohol intake < 14 units/week (19·3 *v.* 6·6 and 6·0 %, respectively).

Food and beverages, energy and macronutrient intake in relation to alcohol intake

Table 2 describes intake of alcoholic beverages, foods and other beverages across categories of alcohol consumption. With increasing alcohol intake, a larger proportion of total intake of alcoholic beverages consisted of beer. Beer represented, by far, the largest volume of alcoholic beverages consumed for men while this pattern was not as explicit for women. For most foods and beverages, there was no significant difference in consumption across alcohol categories, except for higher consumption of sugar-sweetened beverages for both men and women ($P = 0{\cdot}018$ and $0{\cdot}006$, respectively). A higher consumption of sweets and snacks ($P = 0{\cdot}016$) and sweetened beverages total ($P = 0{\cdot}011$) and a lower consumption of cakes and desserts ($P = 0{\cdot}012$)

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Table 1 Socio-demographic information according to categories of weekly alcohol consumption*. Men and women participating in StudentKost

	Men (*n* 178)						Women (*n* 444)					
	Abstaining (*n* 28)		≤ 14 units/week (*n* 92)		> 14 units/week (*n* 58)		Abstaining (*n* 76)		≤ 14 units/week (*n* 311)		> 14 units/week (*n* 57)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (year)	23·6	4·2	23·7	4·4	23·6	4·0	23·8	4·8	23·4	4·5	23·0	3·5
Weight (kg)	82·2	18·0	80·4	13·4	82·0	13·1	66·2	13·1	67·1	12·1	71·0	14·4
Height (kg)	182	7	182	8	182	7	168	7	168	6	168	6
BMI (kg/m^2)†	24·7	5·3	24·1	3·3	24·6	3·2	23·5	4·3	23·7	4·0	25·0	4·8
Overweight/obesity	*n*	%	*N*	%	*n*	%	*n*	%	*n*	%	*n*	%
BMI ≥ 25 (kg/m^2)	12	42·9	27	29·3	20	34·5	21	27·5	86	28·5	20	35·1
BMI ≥ 30 (kg/m^2)	2	7·1	5	5·4	4	6·9	5	6·6	18	6·0	11	19·3‡
Education	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
High school	12	43	49	53	23	40	35	46	138	44	27	47
≤ 4 years of university	26	34	34	37	27	47	26	34	106	34	22	39
> 4 years of university	3	11	8	9	8	14	13	17	53	17	5	9
Health behaviours	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Eats ≥ 500 g fruits and vegetables/d	1	4	5	5	6	10	10	13	32	10	6	11
Eats ≥ 250 g vegetables/d	1	4	4	4	4	7	6	8	27	9	7	12
Physical activity at least 150 min/week	14	50	44	49	19	33	36	47	132	43	21	37
Conscious about healthy eating	10	36	43	47	29	50	39	51	166	54	38	67
Smoking	1	4	3	3	2	3	0	0	16	5	2	4
Snuff	9	32	17	19	9	16	14	18	63	20	11	19
Alcoholic beverages (ml/d)	Median	IQR	Median	IQR	Median	IQR	Median	IQR	Median	IQR	Median	IQR
Beer	0	0, 0	71	36, 250	429	393, 607	0	0, 0	36	0, 71	286	107, 429
Wine	0	0, 0	0	0, 7	0	14, 29	0	0, 0	7	7, 21	29	11, 50
Cider	0	0, 0	0	0, 3	0	0, 62	0	0, 0	36	0, 59	279	107, 433
Spirits	0	0, 0	0	0, 3	9	3, 20	0	0, 0	3	0, 6	11	3, 31

*1 unit of alcohol equivalent to 8 g of alcohol by weight and 14 units of alcohol/week represents the UK Chief Medical Officers' Low Risk Drinking Guidelines 2016 cut-off for low-risk alcohol consumption[18].
†BMI: 9 missing values for women.
‡BMI > 30 P_{trend} (linear-by-linear association) 0·009, χ^2 $P = 0·002$.

across alcohol consumption categories were observed for men only.

Energy intake, absolute intake of carbohydrate, fat, protein and alcohol in grams per day and their relative contribution to total energy intake across increasing alcohol intake are presented in Table 3. Energy intake increased with increasing alcohol intake for both genders ($P > 0·001$), as did the absolute intake of fat ($P = 0·027$ for men and $P = 0·031$ for women), carbohydrates ($P < 0·001$) and added sugar ($P = 0·011$ for men and $P < 0·001$ for women) (Table 3).

Estimates of the associations between weekly alcohol consumption in 2-unit increments and log-transformed nutrient variables are presented in Table 4. For male students, energy intake and absolute intake of carbohydrates, added sugar and PUFA were positively associated with alcohol consumption. The relative contribution of energy from total fat, SFA, MUFA and protein was, however, inversely associated with weekly alcohol consumption. For female students, energy intake and absolute intake of fat, SFA, MUFA, PUFA, carbohydrates, added sugar, salt and protein were positively associated with alcohol consumption, as was the contribution of energy from added sugar. The relative contribution of energy from total fat, MUFA, PUFA and protein was inversely associated with alcohol intake.

Micronutrient intake in relation to alcohol intake

Estimates of the associations between weekly alcohol consumption in 2-unit increments and log-transformed

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Table 2 Daily food and beverage consumption across categories of weekly alcohol consumption*. Men and women participating in StudentKost

	Men (*n* 178)						Women (*n* 444)					
	Abstaining *n* 28		≤ 14 units/week *n* 92		> 14 units/week *n* 58		Abstaining *n* 76		≤ 14 units/week *n* 311		> 14 units/week *n* 57	
	Median	IQR	Median	IQR	Median	IQR	Median	IQR	Median	IQR	Median	IQR
Alcoholic beverages (ml/d)												
Beer	0	0, 0	71	36, 250	429	393, 607	0	0, 0	36	0, 71	286	107, 429
Wine	0	0, 0	0	0, 7	0	14, 29	0	0, 0	7	7, 21	29	11, 50
Cider	0	0, 0	0	0, 3	0	0, 62	0	0, 0	36	0, 59	279	107, 433
Spirits	0	0, 0	0	0, 3	9	3, 20	0	0, 0	3	0, 6	11	3, 31
Food and drinks												
Fruit total	44	30, 115	58	23, 109	51	29, 157	107	49, 196	93	46, 162	84	43, 153
Vegetables total	56	23, 108	77	37, 106	83	46, 152	103	60, 152	108	64, 162	83	41, 170
F&V total	124	56, 216	143	84, 230	175	96, 262	230	140, 341	210	139, 333	200	115, 317
Potatoes, rice and pasta	114	79, 160	125	79, 173	143	77, 203	129	85, 160	117	72, 165	121	88, 165
Fish total	25	5, 43	32	11, 47	29	11, 50	26	11,50	32	14, 52	30	13, 59
Meat total	139	95, 222	110	82, 145	144	89, 201	91	43, 140	89	82, 120	91	64, 143
Whole grain bread and cereal	101	18, 140	75	25, 140	100	34, 149	100	30, 142	66	32, 140	66	32, 118
Cheese	26	8, 51	14	5, 30	15	3, 28	9	3, 22	11	5, 20	14	8, 31
Eggs	27	8, 78	35	16, 71	54	9, 89	20	0, 35	25	9, 71	25	9, 25
Sweet spreads	4	0, 16	3	0, 9	3	0, 7	3	0, 10	3	0, 7	3	0, 7
Milk unsweetened	86	4, 446	57	14, 200	57	14, 200	50	4, 143	57	14, 157	57	14, 200
Milk total	140	46, 500	124	55, 250	135	55, 292	106	40, 196	98	41, 229	145	51, 261
Fruit juice	0	0, 29	14	0, 29	29	0, 57	14	0, 57	14	0, 29	29	14, 93
Sweetened beverages†	371	127, 605	207	87, 387	389	141, 689	246	64, 511	200	86, 450	250	93, 793
Sugar-sweetened beverages‡	150	14, 354	86	36, 179	154	64, 361	50	0, 143	64	36, 143	86	36, 286
Cakes and desserts†	40	22, 68	22	11, 39	21	12, 43	22	12, 39	26	15, 39	31	16, 41
Sweets and snacks†	19	8, 32	16	11, 21	21	15,30	17	12, 29	20	13, 27	25	15, 32

*1 unit of alcohol equivalent to 8 g of alcohol by weight and 14 units of alcohol per week represents the UK Chief Medical Officers' Low Risk Drinking Guidelines 2016 cut-off for low-risk alcohol consumption[18].
†$P < 0{\cdot}05$ for men only (Kruskal–Wallis).
‡$P < 0{\cdot}05$ for both men and women (Kruskal–Wallis).

energy-adjusted micronutrient variables are presented in Table 4. Among men, we observed significant inverse associations between alcohol consumption and energy-adjusted intake of thiamine, phosphate, Fe, Zn and Se, on the order of 0·3–0·6 % lower nutrient density per 2-unit weekly increase in alcohol consumption. This translates into a difference of 6–10 % for thiamine, Fe and P, and a difference of 12 % for Zn and Se from the lowest to the highest category of alcohol consumption.

Among women, there were significant inverse associations between alcohol consumption and energy-adjusted intake vitamin A, β-carotene, vitamin E and C, as well as thiamine, vitamin B_6, folate, P, Mg, K, Fe, Zn and Cu on the order of 0·3–1·9 % lower nutrient density per 2-unit weekly increase in alcohol consumption. This translates into a difference of 6–10 % for vitamin E, thiamine, vitamin B_6, folate, P, Mg, K, Fe, Zn and Cu, 12–20 % for vitamin A and C and 38 % for β-carotene from the lowest to the highest category of alcohol consumption.

Probability of inadequate micronutrient intake across alcohol intake categories

Finally, we assessed the proportion of participants with relatively high probability of inadequate micronutrient intake, defined as a total intake of the respective micronutrient lower than age- and gender-specific AR[20] (Table 4). The proportion of participants with micronutrient intakes below AR varied between alcohol consumption categories and was generally high for vitamin A, vitamin D, folate and I for both genders, in addition to thiamine and vitamin C for men, and Fe for women. The magnitude of these proportions was not, however, related to level of alcohol intake. If anything, there was indication of a lower probability of inadequate intake with higher weekly alcohol intake (Table 5).

Discussion

More than four in five men and women in this sample of Norwegian students reported having consumed alcoholic

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Table 3 Energy, macronutrient and micronutrient intake according to categories of weekly alcohol consumption*. Men and women participating in StudentKost

	Men (*n* 178)						Women (*n* 444)					
	Abstaining (*n* 28)		≤ 14 units/week (*n* 92)		> 14 units/week (*n* 58)		Abstaining (*n* 76)		≤ 14 units/week (*n* 311)		> 14 units/week (*n* 57)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Kilojoule (kJ)	9862	3822	8654	2728	10 791	2854	8508	3152	8273	2734	10 375	3680
Kilocalories (kcal)	2350	911	2063	650	2573	679	2026	751	1971	652	2472	875
Fat (g)	96	41	80	29	91	29	76	31	74	30	86	34
SFA	37	16	30	12	33	12	27	12	27	13	32	13
MUFA	37	17	31	11	36	12	30	12	29	11	33	13
PUFA	13	7	12	5	14	5	12	6	11	5	12	6
Trans-fatty acids	1·0	0·5	0·8	0·4	0·8	0·4	0·7	0·4	0·7	0·4	0·8	0·4
n-3 fatty acids	2·8	1·8	2·7	1·8	3·0	1·4	2·6	1·6	2·4	1·3	2·7	1·4
n-6 fatty acids	9·9	5·5	9·1	4·1	10·7	3·7	8·9	4·3	8·6	3·4	9·5	4·1
Carbohydrates (g)	254	106	217	82	274	86	233	87	218	79	274	110
Added sugar (g)	45	33	32	28	48	41	33	33	34	32	58	51
Dietary fibre (g)	21	9	21	12	24	11	26	13	23	10	24	10
Protein (g)	107	40	95	31	106	35	90	39	87	31	97	40
Alcohol (g/d)	0	0	7	5	27	11	0	0	6	4	24	8
Salt (g)	10·4	4·7	9·8	4·5	10·9	4·2	8·6	4·0	8·5	3·9	9·9	4·1
Total fat (E %)	37	4	35	6	32	5	33	6	34	6	31	4
SFA	14	3	13	3	11	3	12	3	12	3	12	2
MUFA	14	2	14	3	13	2	13	2	13	2	12	2
PUFA	4·7	1·2	5·1	1·3	4·8	1·2	5·1	1·2	5.1	1·1	4·5	1·1
Trans-fatty acids	0·4	0·2	0·3	0·2	0·3	0·1	0·3	0·2	0·3	0·1	0·3	0·1
n-3	1·0	0·4	1·2	0·6	1·1	0·4	1·1	0·5	1·1	0·5	1·0	0·4
n-6	3·6	1·0	3·9	0·9	3·7	0·8	3·9	0·9	3·9	0·8	3·5	0·9
Carbohydrates (E %)	43	5	42	8	42	6	46	7	44	7	44	6
Added sugar (E %)	7·6	5·3	6·4	5·3	7·6	5·9	6·6	6·1	6·7	4·8	8·8	5·8
Dietary fibre (g/10 MJ)	22	8	23	8	22	8	31	12	28	9	23	7
Protein (E %)	18	3	19	4	16	3	18	3	18	3	16	3
Alcohol (E %)	0	0	2·5	1·8	7·7	3·7	0	0	2·1	1·6	7·2	2·3
Vitamin A RAE (µg/10 MJ)	1144	919	905	592	1029	733	1115	984	1142	934	862	553
Retinol (µg/10 MJ)	966	899	738	571	829	738	849	1006	887	930	691	550
B-carotene (µg/10 MJ)	2148	1943	2024	1475	2421	2095	3206	2748	3084	2094	2066	1157
Vitamin D (µg/10 MJ)	5·7	3·4	6·8	3·7	6·0	3·6	6·0	3·3	6·5	3·5	6·0	2·7
Vitamin E(mg/10 MJ)	12·7	3·3	14·5	4·9	13·6	3·9	13·8	2·9	14·3	3·6	12·8	3·4
Thiamin (mg/10 MJ)	1·6	0·3	1·8	0·4	1·5	0·3	1·8	0·3	1·7	0·3	1·6	0·3
Riboflavin (mg/10 MJ)	2·2	1·1	2·3	0·8	2·3	0·9	2·2	1·1	2·2	0·7	2·3	1·0
Niacin (mg/10 MJ)	28	16	30	12	27	13	28	14	27	10	10	26	14
Vitamin B_6 (mg/10 MJ)	2·1	0·7	2·4	0·7	2·2	0·7	2·4	0·6	2·3	0·5	0·5	2·2	0·6
Folate (µg/10 MJ)	274	98	298	92	285	81	350	127	334	111	111	302	95
Vitamin B_{12} (µg/10 MJ)	7·7	3·2	7·7	2·9	7·1	2·8	7·0	3·5	7·3	2·8	2·8	6·8	2·8
Vitamin C (mg/10 MJ)	83	54	99	64	93	53	133	76	124	66	66	110	62
Ca (mg/10 MJ)	1078	431	904	321	876	296	913	295	933	314	314	929	250
P (mg/10 MJ)	1959	369	1959	335	1765	330	1967	327	1949	311	311	1760	293
Mg (mg/10 MJ)	368	93	385	71	376	79	427	79	416	79	79	387	68
K (g/10 MJ)	3726	1000	3991	884	3792	885	4477	1053	4334	923	923	3925	756
Fe (mg/10 MJ)	11·3	2·3	11·9	2·2	10·9	2·0	12·4	2·4	12·5	2·3	2·3	11·4	1·9
Zn (mg/10 MJ)	14·1	2·2	13·9	3·0	12·1	2·1	13·4	2·1	13·2	2·0	2·0	11·7	1·9
Cu (mg/10 MJ)	1·2	0·3	1·3	0·3	1·2	0·3	1·5	0·4	1·4	0·3	0·3	1·3	0·3
Se (µg/10 MJ)	54	19	63	23	53	18	53	19	56	19	19	50	17
I (µg/10 MJ)	155	81	159	102	146	84	150	75	159	79	79	142	70

RAE, retinol activity equivalents.
*1 unit of alcohol equivalent to 8 g of alcohol by weight and 14 units of alcohol per week represents the UK Chief Medical Officers' Low Risk Drinking Guidelines 2016 cut-off for low-risk alcohol consumption[18].

beverages the past 4 weeks and one-third of the men exceeded the upper recommended limit of 14 UK alcohol units/week. Alcohol intake was positively associated with energy and macronutrient intake but inversely associated with the micronutrient density of their diet. A substantial proportion of participants had vitamin D, folate, Fe and I intakes below AR, indicating relatively high probability of inadequate intake. No relationship between alcohol consumption level and the proportion of participants with micronutrient intake below AR was observed.

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Table 4 Associations between alcohol consumption and log-transformed energy and nutrient intake among men and women in StudentKost. Alcohol intake measured per 2 units of alcohol/week intervals*

	Men (*n* 178)				Women (*n* 444)			
Log-transformed diet variables	*β*	SE	95 % CI	*P*	*β*	SE	95 % CI	*P*
Kilojoule (kJ)	0·009	0·002	0·005, 0·014	< 0·001	0·011	0·002	0·008, 0·015	< 0·001
Fat (g)	0·004	0·002	−0·001, 0·008	0·133	0·008	0·002	0·004, 0·013	< 0·001
SFA	0·002	0·003	−0·003, 0·008	0·398	0·010	0·003	0·005, 0·015	< 0·001
MUFA	0·005	0·002	0·000, 0·009	0·061	0·008	0·002	0·003, 0·012	0·001
PUFA	0·007	0·003	0·001, 0·012	0·027	0·007	0·002	0·002, 0·011	0·002
Carbohydrates (g)	0·010	0·003	0·005, 0·016l	< 0·001	0·010	0·002	0·006, 0·015	< 0·001
Added sugar (g)	0·019	0·005	0·009, 0·030	< 0·001	0·027	0·004	0·019, 0·035	< 0·001
Protein (g)	0·004	0·002	−0·001, 0·008	0·089	0·006	0·003	0·002, 0·011	0·003
Salt (g)	0·004	0·003	−0·002, 0·010	0·188	0·009	0·003	0·004, 0·014	0·001
Fat (E %)	−0·006	0·001	−0·008, −0·004	< 0·001	−0·003	0·001	−0·005, −0·001	0·001
SFA	−0·007	0·002	−0·010, −0·004	< 0·001	−0·001	0·002	−0·004, 0·002	0·392
MUFA	−0·005	0·001	−0·007, −0·003	< 0·001	−0·004	0·001	−0·006, −0·002	0·001
PUFA	−0·003	0·002	−0·006, 0·000	0·073	−0·005	0·001	−0·007, −0·002	< 0·001
Carbohydrates (E %)	0·001	0·001	−0·001, 0·003	0·422	−0·001	0·001	−0·003, 0·001	0·227
Protein (E %)	−0·006	0·001	−0·008, −0·003	< 0·001	−0·005	0·001	−0·007, −0·003	< 0·001
Added sugar (E %)	0·010	0·005	0·000, 0·020	0·054	0·016	0·004	0·008, 0·023	< 0·001
Vitamin A, RAE (μg/MJ)	−6·322 E-5	0·004	−0·008, 0·008	0·987	−0·008	0·003	−0·014, −0·001	0·016
Retinol (μg/MJ)	0·000	0·005	−0·010, 0·011	0·924	0·000	0·005	−0·009, 0·009	0·942
B-carotene (μg/MJ)	−0·001	0·004	−0·010, 0·007	0·760	−0·019	0·004	−0·026, −0·011	< 0·001
Vitamin D (μg/MJ)	−0·002	0·005	−0·012, 0·007	0·064	−0·001	0·004	−0·009, 0·006	0·701
Vitamin E (mg/MJ)	−0·002	0·002	−0·006, 0·002	0·322	−0·005	0·001	−0·008, −0·002	< 0·001
Thiamin (mg/MJ)	−0·005	0·001	−0·007, −0·002	< 0·001	−0·005	0·001	−0·007, −0·003	< 0·001
Riboflavin (mg/MJ)	0·002	0·002	−0·002, 0·006	0·278	0·002	0·002	−0·001, 0·006	0·236
Niacin (mg/MJ)	−0·001	0·002	−0·005, 0·004	0·684	−0·002	0·002	−0·006, 0·001	0·200
Vitamin B_6 (mg/MJ)	0·000	0·002	−0·004, 0·003	0·825	−0·004	0·001	−0·007, −0·001	0·002
Folate (μg/MJ)	−0·002	0·002	−0·006, 0·002	0·965	−0·005	0·002	−0·008, −0·001	0·010
Vitamin B_{12} (μg/MJ)	0·000	0·004	−0·008, 0·007	0·301	0·002	0·004	−0·005, 0·009	0·609
Vitamin C (mg/MJ)	−0·004	0·004	−0·011, −0·004	0·328	−0·007	0·003	−0·012, −0·001	0·018
Ca (mg/MJ)	−0·003	0·002	−0·008, 0·001	0·118	0·001	0·002	−0·002, 0·005	0·453
P (mg/MJ)	−0·004	0·001	−0·006, −0·002	< 0·001	−0·004	0·001	−0·006, −0·002	< 0·001
Mg (mg/MJ)	−0·001	0·001	−0·003, 0·002	0·673	−0·003	0·002	−0·006, −0·001	0·002
K (g/MJ)	−0·002	0·001	−0·005, 0·001	0·147	−0·005	0·001	−0·007, −0·002	< 0·001
Na (g/MJ)	−0·005	0·002	−0·010, 0·000	0·050	−0·003	0·002	−0·007, 0·001	0·217
Fe (mg/MJ)	−0·003	0·001	−0·006, −0·001	0·014	−0·003	0·001	−0·005, −0·001	0·012
Zn (mg/MJ)	−0·006	0·001	−0·008, −0·004	< 0·001	−0·005	0·001	−0·007, −0·003	< 0·001
Cu (mg/MJ)	−0·002	0·001	−0·005, 0·001	0·156	−0·004	0·001	−0·007, −0·002	0·001
Se (μg/MJ)	−0·005	0·002	−0·009, 0·000	0·043	−0·003	0·002	−0·007, 0·001	0·191
I (μg/MJ)	−0·006	0·003	−0·012, 0·000	0·054	−0·003	0·003	−0·008, 0·002	0·285

RAE, retinol activity equivalents.
*1 unit of alcohol equivalent to 8 g of alcohol by weight.

The prevalence of alcohol consumption in the current study is in line with regional data from the Global Burden of Disease project showing that > 80 % of male and female Norwegians aged 18–49 years are alcohol consumers[1]. The fact that one-third of the men in our sample exceeded the low risk alcohol consumption cut-off should alert public health authorities that alcohol is a prevalent exposure among the young and a potential threat to public health. The true prevalence of risky alcohol behaviour among Norwegian students could be even higher. The nation-wide SHOT-survey that was carried out in 2018 among 50 054 Norwegian full-time students with 31 % response rate categorised 44 % of the students as having a risky alcohol consumption level, although this classification was based on more aspects of alcohol consumption than ours[22]. Even though fewer women were categorised as having excessive alcohol consumption in our study, the widespread lower level of consumption may still have the potential to influence health[1]. Except for advising total abstinence from alcohol during pregnancy, Norwegian health authorities have not issued specific limits regarding weekly alcohol consumption beyond encouraging limited alcohol intake and to avoid getting drunk. The strikingly different prevalence of excessive alcohol use depending on different definitions demonstrated in our sample, point to a need for standardisation across countries and agreed-upon recommendations on what constitutes risky alcohol-related behaviours.

Alcohol is metabolised in the body to the toxic and highly reactive metabolite, acetaldehyde and further to acetoacetate which is less toxic and can be completely metabolised in liver cells[3]. The peak concentration of acetaldehyde depends upon several factors, among them nutritional intake and nutritional status[3]. One of the mechanisms by which alcohol metabolism exerts its metabolic and toxic effects is by disturbing the intracellular tightly

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Table 5 Proportion % of participants with micronutrient intake below average requirement (AR)* across alcohol intake categories† among men and women in StudentKost

	Men (*n* 178)				Women (*n* 444)			
		Abstaining (*n* 28)	≤ 14 units/week (*n* 92)	> 14 units/week (*n* 58)		Abstaining (*n* 76)	≤ 14 units/week (*n* 311)	> 14 units/week (*n* 57)
	AR*	%	%	%	AR*	%	%	%
Vitamin A	600 µg	32·1	42·4	29·3	500 µg	36·8	28·6	24·6
Vitamin D	7·5 µg	64·3	70·7	67·2	7·5 µg	80·3	76·5	68·4
Vitamin E	6 mg	21·4	5·4	5·2	5 mg	2·6	3·2	0
Thiamin	1·2 mg	28·6	34·8	27·6	0·9 mg	9·2	17·0	5·3
Riboflavin	1·4 mg	21·4	25·0	8·6	1·1 mg	22·4	20·3	5·3
Niacin	15 mg	21·4	13·0	12·1	12 mg	13·2	12·5	7·0
Vitamin B_6	1·2 mg	17·9	15·2	8·6	1·0 mg	5·3	8·4	0
Folate	200 µg	32·1	35·9	15·5	200 µg	32·9	30·9	26·3
Vitamin B_{12}	1·4 µg	3·6	2·2	0	1·4 µg	5·3	1·6	0
Vitamin C	60 mg	39·3	41·3	31·0	50 mg	10·5	19·0	14·0
Ca	500 mg	17·9	26·1	12·1	500 mg	22·4	23·2	10·5
P	450 mg	0	0	0	450 mg	0	0	0
Fe	7 mg	21·4	19·6	15·5	10 mg	55·3	46·6	35·1
Zn	6 mg	10·7	4·3	3·4	5 mg	2·6	3·5	0
Cu	0·7 mg	17·9	15·2	8·6	0·7 mg	13·2	13·8	1·8
Se	35 µg	32·1	18·5	10·3	30 µg	25·0	24·4	21·1
I	100 µg	32·1	39·1	24·1	100 µg	46·1	41·5	42·1

*Age- and gender-specific average requirement of micronutrients according to Nordic Nutrition Recommendations 2012[20]
†1 unit of alcohol equivalent to 8 g of alcohol by weight and 14 units of alcohol per week represents the UK Chief Medical Officers' Low Risk Drinking Guidelines 2016 cut-off for low-risk alcohol consumption[18].

controlled ratio of nicotinamide adenine dinucleotide (NAD+) to reduced NAD (NADH), leading in turn to high levels of NADH and disturbed fat metabolism[3]. Inherent to these disturbances is an increased level of oxidative stress.

Nutritional status is always affected among high alcohol consumers[3]. A high level of alcohol consumption impairs intestinal absorption of nutrients and leads to increased loss of nutrients in urine[3]. Deficiencies in ascorbic acid, thiamine, Mg, P, vitamin D and protein are frequent among high alcohol consumers[3]. In addition, nutritional status may be compromised by the toxic and metabolic effects of alcohol degradation. Alcohol also promotes the breakdown of vitamin A and reduces cell levels of vitamin E and glutathione[3], all important components in cell antioxidant defence systems.

Alcohol is an energy-dense compound that over time may contribute to unwanted or undesirable weight gain and overweight/obesity. In our study, increasing alcohol intake was positively and consistently associated with higher energy intake among both men and women, but only women with excessive alcohol intake had higher mean BMI and a significantly higher proportion of obesity compared to those with lower or no alcohol consumption (Tables 1 and 3). Given the cross-sectional nature of our data, we do not know whether these observations reflect causal associations. As weight and height were self-reported, we cannot exclude under- or overreporting of height and weight, nor differential degree of misreporting between genders and across alcohol consumption categories. A higher degree of underreporting might be the case among women in the lower alcohol consumption groups contributing to the large difference in obesity, but this remains to be investigated. As a group, women with high alcohol intake had indications of a less healthy diet, with lower intake of fruits and vegetables and higher intake of non-core foods (Table 2). In a systematic review and meta-analysis of twenty-two studies involving 701 participants, Kwok *et al.* demonstrated that alcoholic beverage consumption significantly increased food energy intake by a mean of 343 kJ (95 % CI 161, 525) and total energy intake by 1072 kJ (95 % CI 820, 1323) compared with no consumption[7]. The authors conclude that adults do not seem to compensate appropriately for alcohol energy by eating less and that even a relatively modest amount of alcohol may lead to increased food consumption (ibid). As overweight and obesity represent a threat to public health, not least in a preconception health perspective[4], this aspect of alcohol consumption should not be neglected. Albani *et al.*[23] examined associations between BMI and energy intake from alcohol and found that young adults drinking the highest levels of alcohol on a single occasion were more likely to be obese than those with the lowest intakes[23]. Sprake *et al.*[24]investigated associations between dietary patterns of university students and associated nutrient profiles and reported that a 'convenience, red meat and alcohol' dietary pattern exhibited strong correlation with energy intake. In the National FINRISK 2007 study, alcohol consumption among men and women was associated with the so-called normal weight obesity, defined as BMI < 25 kg/m^2, but with excessive body fat (≥ 20 % for men and ≥ 30 % for women)[25].

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Fazzino *et al.* prospectively examined students' alcohol consumption during the first year of college in relation to changes in weight and adiposity during the same period[26]. Although 28 % experienced a weight gain of more than 2·3 kg, differences in anthropometric changes could not be explained by alcohol consumption.

The magnitude of the associations between alcohol intake and the micronutrient density of diet seemed modest for most micronutrients. Yet, the estimates translated into 6–38 % lower micronutrient density from the lowest to the highest alcohol consumption level depending on the micronutrient in question. For women, the observed inverse association between alcohol intake and nutrient intake was strongest for the natural antioxidants, that is, vitamin A, β-carotene, vitamin C and vitamin E. This may be of particular concern given the oxidative stress induced by alcohol consumption combined with the adverse effect of alcohol on antioxidant enzymes and chemicals such as the catalase and superoxide dismutase enzyme and glutathione[27]. In addition, the lower dietary nutrient density of Fe, Zn and Cu, all cofactors in enzymatic oxidative defence systems, could contribute to compromised oxidative defence[27]. For male students, the inverse associations between alcohol intake and nutrient intake were evident for Zn, Se, thiamine, Fe and P. Se and Zn are cofactors in enzymatic oxidative defence systems that may ameliorate the oxidative stress of alcohol metabolism[27]. Deficiency of thiamine and other B-vitamins is prevalent among high alcohol users, likely due to a combination of reduced intake and increased metabolic need[3]. Sprake *et al.* reported inverse correlations between increasing adherence to a 'convenience, red meat and alcohol' dietary pattern and most energy-adjusted micronutrients[24]. Even though the mentioned factor analysis-derived dietary pattern only partly reflects absolute alcohol intake, their observations are in line with our findings.

Although micronutrient density of diet was inversely associated with weekly alcohol intake in our study, this did not translate into an increased probability of inadequate micronutrient intake across categories of alcohol intake. This means that the lower micronutrient density across alcohol categories was, at least to some extent, compensated for by increased absolute intake of energy and micronutrients. At any level of alcohol consumption, a surprisingly high proportion of both male and female students had micronutrient intakes below AR and thus a relatively high probability of inadequate intake of vitamin A, vitamin D, vitamin C (men), folate, Ca, Fe (women), Se and I. As our findings are confined to dietary data, we do not know whether and to which degree participants with or without excessive alcohol consumption had biochemical indications of compromised nutritional status. It is, however, conceivable that higher levels of alcohol consumption could render individuals more vulnerable to the metabolic effects of inadequate micronutrient intake[3,20].

In a preconception public health perspective, both alcohol consumption and suboptimal micronutrient intake among young adults are of concern. Many pregnancies are not planned for[28] and unintended pregnancy is more common among the young, people with less education, those not living with a partner and students[29]. Alcohol intake affects developing eggs and sperm which in the case of conception represents the origins of hundreds of stable cell lineages, making up organs and body structures in the fetus[30]. What may be considered as normal alcohol-related behaviours among young adults have the potential to unintentionally affect long-term health, cognitive development and behaviour in their prospective children[6]. Nykjaer *et al.* found a strong inverse association between women's reported alcohol intake 4 weeks before pregnancy and offspring birthweight and subsequent pattern of growth[31]. Compared with non-drinkers, alcohol intake above two units/week in the last 4 weeks before conception was associated with a significant decrease (−7·7) in customised birth centile[31]. Two-thirds of participants in the study of Nykjaer *et al.* had an alcohol intake above two units/week.

The high proportion of participants with potentially inadequate intake of vitamin A, D, folate, Fe and I is of concern per SE, as these nutrients have targeted roles in embryogenesis and early fetal development. Vitamin A is essential for male and female reproductive health, and for many events in the developing embryo[32]. More than one-third (38 %) of men in our study had a high probability of inadequate vitamin A intake, while the corresponding number for women was 30 % (data not shown). Likewise, vitamin D has fundamental roles in both male[33] and female reproductive function[34]. Inadequate folate status in women prior to conception is a well-known risk factor for neural tube defects in the fetus[35]. More recently, there has been increasing focus on folate in relation to male fertility[36]. Marginal folate status has been associated both with erectile dysfunction[37,38] and with impaired fertility and spermatogenesis[36,39].

The stable carbohydrate contribution to total energy intake across alcohol intake, but lower contribution of protein, total fat and fatty acids to total energy intake, probably reflects the necessary dilution effect by the contribution of energy from alcohol in combination with increased carbohydrate intake associated with the consumption of alcohol-containing beverages. When simple carbohydrates replace essential nutrients such as protein and essential fatty acids, there is a risk for compromised nutritional status. In the present case, both protein and total fat intake were relatively high and not likely to compromise nutritional status in any group. Besides, absolute intake of fats and protein was not lower in the higher alcohol consumption groups.

Study strengths and limitations

The aim of the current study was to assess alcohol intake among students and investigate whether level of alcohol intake is associated with nutritional parameters. Strengths

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of the study are the detailed data on consumption of alcoholic beverages and the comprehensive information on energy and nutrient intake based on calculations from a validated and reproducibility-tested FFQ[12]. Since participants had to respond to all questions to complete the questionnaire, there were few missing values in the dataset. There are, however, also limitations that need to be discussed. The cross-sectional design of the present study only allows for description of energy and nutrient intake across alcohol consumption categories and does not imply causal associations between alcohol consumption and nutritional indicators. Some dietary information may have been missed due to crude categorisations of fruits and vegetables in the questionnaire. This may have contributed to the seemingly high proportion of students with inadequate intake of vitamin A and C. Potential misreporting of alcohol consumption may have led to misclassification of level of alcohol intake, meaning that the prevalence of excessive alcohol consumption may be higher or lower than reported in this paper. Potential misreporting of diet would likewise lead to misrepresentation of true energy and nutrient intake. The fact that dietary data from FFQ may not accurately represent true dietary intake must also be taken into account. Absolute energy and nutrient intakes and the proportions of participants with a high probability of inadequate intake should therefore be interpreted with caution. On the other hand, given that underreporting of unhealthy foods and overreporting of healthy foods is common in dietary surveys[40], true challenges related to suboptimal nutrient intakes could be even greater than our findings suggest. The fact that participants were asked to report on dietary intake pertaining to the last 4 weeks could also limit the reliability and generalisability of our findings. Four weeks is a short time period regarding nutritional adequacy, as short-term changes in diet due to dieting, illness or mental distress could detract from what would be habitual longer-term diet. It could, however, also be argued that recall bias is likely to be less when participants report from the previous month.

We present dietary intakes as reported by the participants and did not exclude participants on the basis of implausible energy intakes. This may have influenced the proportion of participants with high probability of inadequate intake, especially for energy intake-sensitive nutrient intakes such as Fe and folate. For vitamin A, D, C and I, potential underreporting of energy intake is less likely to have biased our findings.

Generalisability from the current study is clearly an issue considering the low participation rate among those invited to participate. Self-selection favouring a more health-conscious group of students is likely, and even if the sample were representative of students in general, our sample is not likely to be representative of the broader population of young adults. In the previously mentioned nation-wide SHOT-survey among Norwegian full-time students, only 8 % of the responders defined themselves as alcohol abstainers[22]. This underpins that our sample could be somewhat selected, but also makes our findings regarding alcohol use and dietary weaknesses among students even more alarming in a preconception public health perspective.

Relative to their fundamental importance to preconception health, diet and alcohol are not frequently debated. There is a need to discuss how to foster public knowledge and motivation in preparation for parenthood by avoiding actions that may influence the health and benefit of prospective children. Estimates from the Global Burden of Disease (GBD) project show that the level of alcohol consumption that minimises health loss is zero and urges health authorities to aim at reduced levels of consumption throughout populations[1]. While zero alcohol would be an unrealistic and unobtainable goal among those not actively planning a pregnancy, the protection of developing egg and sperm against harmful substances is highly relevant to intergenerational public health. Protective action should be taken to avoid conceiving during periods of excessive alcohol consumption and precautionary advice may be needed for students regarding use of contraception in periods of alcohol use. A range of societal factors could adversely influence students' diet quality, such as limited economic resources, limited time for food planning, inadequate food preparation skills and lack of knowledge regarding the dividends of healthy eating. An increased focus in young adulthood on how to prepare nutritionally for parenthood seems warranted.

In conclusion, alcohol consumption was common among students in the present study and one-third of male students exceeded the criteria for excessive consumption. Weekly alcohol consumption was positively associated with absolute energy and nutrient intake but inversely associated with micronutrient density of diet. Even though the magnitude of most of these associations was modest, many students had micronutrient intakes below AR for age and gender irrespective of alcohol consumption level and, thus by definition, a relatively high probability of inadequate intake.

The high prevalence of excessive alcohol consumption, the inverse associations with micronutrient density and the prevalence of potential micronutrient inadequacy in this sample of university students are of concern in a preconception public health perspective. Our findings call for investigations into young adults' knowledge, beliefs and reflections regarding drinking habits and dietary behaviour in relation to the health and well-being for themselves and their future children.

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