Inadequacies of micronutrient intake in normal weight and overweight young adults (18-25 years): A cross-sectional study

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Table S1: Deficit in micronutrient intake in University students

Micronutrient		gap*
	Males	Females
Folate (mg)	-	28.71
Vitamin D (µg)	5.6	4.96
Calcium (mg)	-	102.56
Magnesium (mg)	34.75	57.38
Iron (mg)	-	6.18
Potassium (mg)	783.78	1256
Selenium (mg)	14.57	19.3

*Deficit has been calculated in comparison with RNI

***Highlights**

Highlights:

Males and females university students (18-25 years) have inadequate intakes of important vitamins and minerals, particularly Vitamin D.

Females seem to have more inadequacies in the diet compared to males with regards to calcium, iron and folate

Overweight and obese individuals have lower intakes of micronutrients compared to normal weight.

Abstract

Objectives: This study aims to assess adequacy in micronutrient intake in comparison with reference nutrient intakes (RNI) and identify differences in intakes between normal weight and overweight individuals.

Study design: A sample of 542 University students (18-25 years), normal weight (N=369) and overweight (N=173) was included in a cross-sectional study.

Methods: A three-day diet diary was used to assess energy and nutrient intake. BMI and waist circumference were measured.

Results: Mean dietary vitamin D intake was lower than RNI in both males (4.44 µg) and females (5.04 µg). Mean intakes of calcium (597.44 mg), iron (8.62 mg) and folate (171.29 mg) were also lower than recommendations in females. Weight status (normal weight versus overweight) was significantly associated with micronutrient intake and a trend towards a decrease in vitamin and mineral intake with increasing weight was noted.

Conclusions: Results suggest the need to increase the intake of some micronutrients to meet the RNI, in order to ensure optimal health. This study provides a helpful tool to reinforce recommendations and potential health promotion and intervention strategies in University settings, and could influence manufacturers involved in new food product development targeted to this young population.

Introduction

There has been an increasing interest in micronutrient malnutrition due to its potential contribution to global disease burden [1]. Deficiency in micronutrients can affect the immune system, influence performance, impair development and cause metabolic disorders [1,2]. Although acute micronutrient deficiency is more prevalent in developing countries, it remains a public health issue in the Western countries [1]. This is mainly due to the increased consumption of high-energy low-micronutrient foods. In Europe, deficiency in iron and iodine have been identified as the most prevalent deficiencies in the adult population [1]. Inadequate micronutrient consumption (particularly iron and folate) is more common in young women in the Western world, due to increased requirements and poor intake [3].

Adolescents and young adults have been described as having poor diet choices that are associated with obesity, meal skipping and snacking [4]. In particular, University students are known to have a low diet quality characterised by a high consumption of convenience and fast foods and a low intake of fruits of vegetables [5]. This could have long-term effects on the occurrence of cardiovascular diseases [6]. Also, as lifestyle choices have been shown to affect peak bone mass by 20-40% and increase osteoporosis risk later in life [7], a unhealthy diet could significantly affect those who are still in the phase of bone growth . According to the UK government, around half of the adult population go onto Higher Education [8]; therefore, identifying micronutrient inadequacies could help develop strategies tailored to this population. Furthermore, it has been shown that obese individuals are at higher risk of nutrient deficiencies compared to normal weight controls with similar age and sex [9,10], yet studies remain fairly limited and none have focused on this issue solely in young adults. Therefore, the aim of this study is to identify the prevalence of micronutrient inadequacies in a sample of 18-25-year-old University students in England and to identify differences in micronutrient intake between BMI categories. This could help target future recommendations and health intervention strategies in Universities, and provide a reference for developing new food products/recipes tailored to young adults.

Methods

Study Design and Participants

After obtaining ethical approval, volunteers aged 18–25 years with no restriction to weight status and gender were recruited by convenience sampling from Universities across the Northwest of England between 2014 and 2016. Participants with known metabolic diseases (diabetes, hypertension and/or cardiovascular diseases) were excluded from the study. The study was conducted within the framework of the Collaborative Investigation on Nutritional Status of Young Adults (CINSYA) in the city of Liverpool, UK. Data collection took place at Liverpool Hope University health sciences Lab. The study is part of an ongoing project that also aims to identify risk factors for diabetes and cardiovascular diseases in young adults.

All participants gave their written informed consent prior to participation. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee at Liverpool Hope University. Demographic data was collected.

Anthropometric Measurements

Participants height was measured in Frankfort Plane position using a SECA201 stadiometer (SECA GMBH & Co, Hamburg, Germany) and weight was measured via Tanita MC-180MA (Tokyo, Japan). Participants wore light clothing, and shoes and socks were removed before stepping on the equipment). A BMI greater than or equal to 30 Kg/m^2 was identified as obese, between 25 - 29.9 Kg/m^2 as overweight, while a BMI between 18-24.9 Kg/m^2 was considered normal [11]. Waist circumference (WC) was measured at the midpoint between the lowest rib and the top of the iliac crest [12].

Diet and Physical Activity

A three-day (two weekdays and one weekend day) integrated diet and physical activity diary was used to assess energy and nutrient intake. The diet diary was extracted from the validated questionnaires of the UK's National diet and Nutrition survey (NDNS) with minimal adjustments [13]. To improve compliance and enhance accuracy, a completed example and food portion pictures were supplied and prompts on time, place and portion sizes were shown in the diet diary. The diaries were analysed for energy, macronutrients and micronutrients using Microdiet dietary analysis software (Microdiet v3, Downlee Systems Ltd, Salford, UK). A validated 3-day physical activity diary produced by Bouchard et al (1983) [14] was used to assess physical activity. Participants reported physical activity for each 15-minute interval over 3 days. The activities ranked from 1 to 9 (sedentary activity to high intensity), and the analysed output of the diary produced total energy expenditure as kcal/kg/day and min/day spent in light/moderate/vigorous activity[14].

Statistical analysis

In order to reduce misreporting, participants with reported average energy intake lower than 800 Kcal or higher than 4200 Kcal were excluded. Data analysis was conducted using SPSS version 24 for Windows (IBM SPSS, Inc., NY, USA). Data are expressed as mean (standard deviation) (SD). The determination of sample size was originally based on its ability to predict an 8% prevalence of metabolic syndrome in the population. However, this sample will have 95% power to detect a vitamin inadequacy of 4% when compared to UK Reference Nutrient Intakes (RNI). Difference between groups based on BMI status was assessed using independent t-test. Pearson and Spearman product-moment correlations were used to examine associations between selected variables. Significance was set at $p<0.05$.

Results

Participant characteristics

After excluding outliers (N=23), 542 young adults were included in the analysis. Females constituted 57% of the sample. Among participants, 86.5% were British and 14.6% were smokers. Characteristics of the study population are presented in Table 1. Males reported practicing an average of 5 hours of moderate to vigorous physical activity a week compared to 3 hours for females (physical activity guidelines of 150 minutes of physical activity per week for both genders [15]). BMI and WC followed a strong linear correlation (r = 0.75, p<0.001).

Macronutrient intake

Compared to UK Dietary reference values (DRVs) [16], mean carbohydrate intake was slightly below the recommendations for both males (48% of daily energy intake) and females (49% of daily energy intake). Mean fat intake met the recommendations of no more than 35% of daily energy intake (33% for males and 35% for females), while mean saturated fat intake was slightly above the recommendations of 11% for males (11.5%) and females (12%).

Vitamin and mineral intakes

Assessment of diet diaries showed that the mean intakes of vitamin A, vitamin D, magnesium, potassium, iodine and selenium were below the RNI recommendations for both males and females (Table 2). Females also reported to have lower intakes of iron, folate and calcium compared to RNI. For vitamin A, females reported to closely meet the RNI, whereas males reported a lower intake of this vitamin. Iodine intake was also reported to be below the RNI recommendations (Table 2). The deficit in micronutrient intake compared to RNI is illustrated in (Supplementary data, Table S1). In addition, participants consumed sodium above the recommendations (2971 mg for men and 2396 mg for women) (Table 2)

Effect of weight status

In males, independent t-test showed a significant difference in levels of iodine and vitamin B2 between participants with BMI < 25 Kg/m^2 (normal) and BMI > 25 Kg/m^2 (overweight). Participants with normal BMI had a higher intake of iodine (80.44 (6.55) mg versus 59 (98.63) mg, *p=0.03*), and vitamin B2 (0.76 (0.8) mg versus 0.69 (0.47) mg, *p=0.03*) compared to those who are overweight. In females, there were significant differences between overweight and normal weight participants for levels of magnesium (87.69 (9.34) mg versus 136 (9.29) mg, $p=0.03$, respectively), iron (3.9 (0.41) versus 4.6 (0.31) mg, $p=0.059$, respectively) and selenium (22.4 (2.35) mg versus 31.74 (2.16), $p=0.056$, respectively). No other significant differences were noted. However, there were no significant differences in reported energy intake between normal weight and overweight in females ($p=0.52$) or males ($p=0.71$). The comparison between overweight (BMI between 25-29.9 Kg/m^2) and obese (BMI> 30 Kg/m^2) participants did not identity significant differences in micronutrient intakes with regards to all nutrients except for sodium which has been reported to be consumed in higher amounts in overweight (3253 mg) compared to obese individuals (2680 mg) ($p>0.05$).

Moreover, spearman's correlation showed negative associations between BMI status (normal weight, overweight and obese) and calcium (r=-0.13, $p=0.05$), magnesium (r=-0.13, $p=0.05$), and vitamin E (-0.17, $p=0.01$) in the male population. In females, there was a negative correlation between BMI status and sodium (r= -0.13, $p=0.02$), calcium (-0.18, $p=0.002$), magnesium (r=-0.12, $p=0.04$), Cu (-0.13, $p=0.02$), iodine (r= -0.14, $p=0.016$) and vitamin B2 (r= -0.16, $p=0.006$). No other significant correlations were noted. However, there was a trend towards a lower intake of micronutrient-dense foods with increasing BMI (Figure 1).

Discussion

This study aims to assess the micronutrient intake in the diet of young adults aged 18-25 years and identify whether weight status is associated with micronutrient intake; a particularly important issue due to the continuous rise of obesity rates in all age categories [17]. Comparing intakes to RNI and not LRNI (Lower Reference Nutrient Intake) was primarily to assess adequacy of vitamin and mineral intake and reinforce recommendations that ensure that the needs of nearly all the population are met and deficiencies are reduced.

Micronutrient intake: Both men and women reported lower dietary intakes of vitamin A, vitamin D, magnesium, potassium, iodine and selenium compared to the relevant RNI. Females also reported to have lower intakes of iron, folate and calcium compared to RNI (Table 2). The low intakes of vitamin D in both groups constitute a serious issue because of the critical role of vitamin D in musculoskeletal and cardiovascular disease [18, 19]. In fact, only 3% of this population reported an intake of vitamin D at the level of 10 µg/day. However, sun exposure plays a substantial role in vitamin status and responsiveness to UV exposure largely varies between individuals [20]. Therefore, no conclusive evidence could be made without biochemical assessment of vitamin D status. The low vitamin intake is yet consistent with many studies undertaken in the UK in different age groups [21,22]. Results are also consistent with NDNS outcomes which reported low blood levels of Vitamin D in one fifth of adults aged between 19-64 years [23]. Despite the current recommendations on consuming vitamin D-rich foods [24], the low intake in comparison with recommendations persists. . The Scientific Advisory Committee on Nutrition (SACN) recommends that all adults consider taking a vitamin D supplement, particularly during autumn and winter [25]. This, along with potential food fortification policies needs to be reinforced/considered for University students and young adults.

For vitamin A, results are inconsistent with the NDNS results and potentially suggest that young adults between 18-25 years might have lower intakes of vitamin A. A potential explanation would be the lack of fruits and vegetables intake in the diet, which are a source of beta-carotene. This suggests to reinforce recommendations in order to achieve adequate intake. Additionally, assessment of iodine intake does not match with the NDNS results. The latter also reported a normal urine iodine concentration in adults aged between 19-64 years. Iodine deficiency constitute an important issue as it is linked to goitre and can cause adverse effects on reproduction in adults [26]. Therefore, further investigations in young adults are needed, and studies analysing urinary iodine concentrations in a sample of young adults along with dietary intake would help clarify the iodine status in this age category.

Iron intake was reported to be lower than the recommendations only in females (58% of RNI) with a deficit of 6.18 mg compared to RNI (Tables 2 & 3). This deficit has shown to be higher than the results obtained in the NDNS report for females aged 19-64 years (76% RNI). Results nearly match with the EFSA (European food safety authority) report showing that iron intake of European women aged 18-49 years is 9.8 (3.8) mg/day [27], which corresponds to a mean deficit of 5 mg compared with the RNI. The low-quality diet of young university students could have resulted in this iron deficit, yet testing indicators of iron status (Ferritin, Haemoglobin) in conjunction with dietary intake would have provided a better overview of iron status in this population. Consequences of low iron status have been well established. Suboptimal iron status and anaemia are associated with weakness, reduced physical work capacity and work tolerance [28-30] and a potential deficit in cognitive function [31]. Therefore, there is a need for developing strategies that aim to eliminate or reduce this deficiency.

In addition to iron, the average female diet seems to be inadequate in folate and calcium (Table 2), the latter are known to play a significant role in reproduction, musculoskeletal health, immunity and performance [1]. Therefore, special attention needs to be provided to these inadequacies. As folate fortification of flour is still under consideration in the UK [32], results provide further supporting evidence for folate fortification of commonly consumed foods. Furthermore, with the emergence of new food products, developing recipes enriched with these nutrients and targeted to young females might be considered. Lastly, deficiencies in magnesium, potassium, selenium and zinc are consistent with the results of NDNS for Years 5 and 6 for the 19-64 age category. However, as limited evidence has been use to set DRVs for the latter nutrients, data should be interpreted with caution [23].

Interestingly, although females reported more inadequacies in micronutrients than males and commonly a higher deficit, the analysis of nutrient density per energy intake showed that males have lower intakes per 1000 Kcal for most nutrients (with the exception of vitamins C and E) (Table 2). Thus, although females' diet appears to be more deficient in nutrients compared to men, it is more micronutrient-dense per Kcal consumed. Therefore, it can be suggested that both men and women need diet improvement with regards to energy: micronutrient ratio, yet the lower energy intake in women renders the micronutrient deficiency more prominent. On the other hand, sodium consumption has been reported to be above the recommendations of 1600 mg in both men and women, which is associated with detrimental consequences on cardiovascular risk [33]. However, sodium intake could be imprecisely measured by dietary assessment. For a more accurate measure of dietary sodium intake, 24 hour urinary sodium excretion could be assessed to better predict the degree of sodium over-consumption. Recommendations need then to be reinforced to lower the intake of high salt foods in this age group.

Effect of weight status: Results suggest a low micronutrient intake in overweight and obese participants compared to normal weight participants for dietary intakes of magnesium (87.69 (9.34) mg versus 136 (9.29) mg, $p=0.03$, respectively*)*, iron *(3.9* (0.41) versus 4.6 (0.31) mg, $p=0.059$, respectively) and selenium (22.4 (2.35) mg versus 31.74 (2.16)*,* $p=0.056$, respectively). Results match with previous studies showing that micronutrient intakes are lower in the obese population compared to normal weight [8, 9]. It would have been valuable to identify the types of foods consumed in this population that have contributed to these differences. Future studies identifying this would be of interest. Interestingly, the non-significant differences in reported energy intake between normal weight and overweight in females *(p=0.52)* or males *(p=0.71)* could be mostly explained by underreporting which can be affected by weight status. In fact, a study reported that in obese individuals, the reported energy intake constituted an average of 59% of their energy expenditure [34]. This suggests the need for potential studies that validate energy intake particularly in obese individuals, and possibly establish a correction factor to the self-reported energy intake. Diet could then be more accurately assessed in future studies. The negative association between BMI status and some micronutrients (calcium, magnesium, iron, iodine, vitamin E and vitamin B2) and the trend towards a lower intake of micronutrient-dense foods with increasing BMI (Figure 1), leads to the suggestion that the extra amount of energy consumed by participants in the overweight population mostly involves low-nutrient dense foods.

Results of this study are useful to assess dietary micronutrient inadequacy in this group of the population and identify the nutrient deficit that would help reinforce recommendations and strategies specific to this age and demographic group. Given the large number of University students in UK higher education, developing health promotion and intervention strategies need to be considered in University settings. As there are some gaps with regards to fortification [1], this study provides further guidance on evidence-based food fortification and food product development that could cover the deficit for most nutrients without risks of excesses and improve the diet without major changes in dietary patterns. A national survey reported that pizza, pasta and curry are among the top consumed foods for those aged between 16-20 years old in the UK [35]. Furthermore, another survey including 2573 students in UK universities reported that the price is the main determinant when buying foods [36]. Therefore, these factors need to be taken into account in any practical recommendations or actions.

Limitations

The study presents limitations with regards to misreporting dietary intake, which is a drawback for all methods assessing diet in a free-living population. However, efforts have been made to limit misreporting by including a visual guide to portion sizes for participants and excluding those with particularly high or low reported energy intake. Using weighed food records may have helped to reduce the bias although this method also has limitations. The use of the 3-day diet diary can also present limitations in assessing typical diet of participants, yet a similar protocol (i.e. the use of three productive days out of completed 4 day-diet diary) was used in NDNS survey. In addition, the lack of biochemical tests did not provide a more accurate index of micronutrient status. Moreover, the assessment of type of food intake in conjunction with micronutrient intake would have been valuable in assessing how dietary habits can affect nutrient intake. Lastly, the limitations of the diet analysis software used did not allow to explore the correlation between other diet components (such as free sugars and fibre intake) and micronutrient ingestion.

Conclusion

This study shows that the diet of University students aged 18-25 years is below recommendations for vitamin D in both genders and for calcium, folate and iron in females. Overweight and obese individuals seemed to have higher inadequacies compared to normal weight. Therefore, there is a need to improve health by reducing vitamin and mineral deficiencies through education to emphasize nutritional recommendations, reinforcement of health intervention strategies and utilisation of potential food fortification/enrichment or targeted supplementation. This will help to ensure optimal health and avoid negative long-term consequences in this young adult population.

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Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned.

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Table 1: Characteristics of the overall population of young adults

	Mean (SD)	
	Males (N=232)	Females (N=310)
Age (years)	21.07 (1.4)	20.7 (1.5)
Physical activity (hours/day)	5	3
BMI (Kg/m^2)	24.52 (3.85)	23.84 (4.32)
Waist circumference (cm)	84.53 (10.4)	77.3 (11.5)

Table 2: Micronutrient intake with comparison to UK Reference nutrient intake in University students (18-25 years).

		Males (N=232)			**Females (N=310)**			
Micronutrients	**Average intake/ day**	**RNI[1]**	**% RNI**	**Nutrient density intake (per 1000 Kcal)[2]**	**Average intake/ day**	**RNI[1]**	**%RNI**	**Nutrient density intake (per 1000 Kcal)**
Vitamins								
Vitamin A (µg)	590	**600**	**84**	120	568	**600**	**95**	277
Thiamin (mg)	1.48	1	148	0.67	1.17	0.8	146	0.66
Riboflavin (mg)	1.48	1.3	114	0.29	1.12	1.1	102	0.68
Niacin (mg)	28.17	17	166	9.66	18.04	13	139	12.67
Vitamin B6 (mg)	2.01	1.4	144	0.81	1.57	1.2	131	0.87
Folate (mg)	220.4	200	110	80.74	171.29	200	**86**	79.79
VitaminB12 (µg)	4.1	1.5	273	0.79	3.01	1.5	201	1.88
Vitamin C (mg)	68	40	170	57	69.83	40	175	22
Vitamin D (µg)	4.44	**10**	**44**	0.28	5.04	**10**	**50**	1.04
Vitamin E (mg)[3]	6.1	-	-	5.04	5.0	-	-	4.46
Minerals								
Calcium (mg)	729.46	700	104	225	597.44	**700**	**85**	327
Phosphorus (mg)	3818.67	550	694	1149	2253.9	550	410	1407
Magnesium (mg)	265.25	**300**	**88**	94	212.62	**270**	**79**	158
Iron (mg)	11.43	8.7	131	5	8.62	**14.8**	**58**	5.49
Zinc (mg)	9.33	**9.5**	**98**	3.85	6.74	**7**	**96**	5.25
Potassium (mg)	2716.22	**3500**	**78**	1149	2243	**3500**	**64**	1407
Iodine (mg)	110.55	**140**	**79**	14.67	82.7	**140**	**59**	58.4
Copper (mg)	1.24	1.2	103	0.47	1.3	1.2	108	0.94
Selenium (mg)	60.43	**75**	**81**	20.91	40.7	**60**	**68**	31.79
Na (mg)	2970.76	1600	186	1562	2395.46	1600	150	1964

RNI: Reference nutrient intake

[1] *RNI are the recommended nutrient intakes for the UK population.*

[2] *Nutrient density intake is the amount of nutrients consumed per 1000 Kcal.*

[3] *The RNIs for Vitamin E have not been set, therefore the percentage of RNI has not been calculated.*

Table 3: Micronutrient intake-related differences in different weight categories.

		Males (N=232)		Females (N=310)	
Micronutrients		**Daily intake** Mean (SD)	**Test of significance (Two-sided)**	**Daily intake Mean (SD)**	**Test of significance (Two-sided)**
Vitamins					
Vitamin A (µg)	Normal weight [1]	640 (755)	0.26	591 (511)	0.28
	Overweight	522 (509)		555 (667)	
	Obese	421 (354)		426 (380)	
Thiamin (mg)	Normal weight	1.54 (0.74)	0.16	1.2 (0.62)	0.23
	Overweight	1.4 (0.51)		1.05 (0.49)	
	Obese	1.27 (0.84)		1.18 (0.53)	
Riboflavin (mg)	Normal weight	1.55 (0.86)	0.1	1.16 (0.69)	0.09
	Overweight	1.38 (0.61)		0.94 (0.5)	
	Obese	1.2 (0.72)		1.19 (1.11)	
Niacin (mg)	Normal weight	29.15 (16.93)	0.3	18.09 (9.16)	0.62
	Overweight	28.88 (12.86)		17.24 (9.06)	
	Obese	23.54 (11.98)		19.23 (9.76)	
Vitamin B6 (mg)	Normal weight	2.11 (1.01)	0.39	1.59 (0.83)	0.64
	Overweight	2.05 (0.79)		1.48 (0.74)	
	Obese	1.8 (0.96)		1.6 (0.66)	
Folate (mg)	Normal weight	233 (137)	0.1	177 (95)	0.63
	Overweight	214 (112)		163 (121)	
	Obese	170 (103)		173 (90)	
Vitamin B12 (µg)	Normal weight	4.24 (3.02)	0.56	3.11 (2.25)	0.28
	Overweight	4.17 (2.8)		2.59 (2.6)	
	Obese	3.5 (2.44)		3.2 (2.69)	
Vitamin C (mg)	Normal weight	69.83 (58.24)	0.15	74.22 (56.33)	0.12
	Overweight	70.7 (64.73)		57.34 (52.66)	
	Obese	129 (378)		70.85 (54.99)	
Vitamin D (µg)	Normal weight	4.74 (7.38)	0.82	5.42 (10.59)	0.33
	Overweight	4.11 (5.12)		3.32 (7.4)	
	Obese	4.96 (8.2)		5.75 (11.63)	
Vitamin E (mg)	Normal weight	6.39 (3.29)	0.11	5.16 (3.2)	0.15
	Overweight	5.8 (3.53)		4.3 (2.49)	
	Obese	4.83 (3.99)		5.08 (2.86)	
Minerals					
Calcium (mg)	Normal weight	742 (332)	0.23	619 (311)	0.15
	Overweight	749 (514)		523 (258)	
	Obese	588 (486)		589 (593)	
Phosphorus (mg)	Normal weight	2919 (1688)	0.3	2294 (995)	0.49
	Overweight	2703 (9820		2115 (1089)	
	Obese	2404 (1786)		2244 (1134)	
Magnesium (mg)	Normal weight	273 (114)	0.06	223 (136)	0.06
	Overweight	268 (140)		180 (840	
	Obese	205 (120)		205 (94)	
Iron (mg)	Normal weight	11.65 (5.37)	0.26	8.93 (4.61)	0.04 *
	Overweight	11.56 (5.96)		7.35 (3.47)	
	Obese	9.52 (5.86)		8.97 (4.51)	
Zinc (mg)	Normal weight	9.6 (5.34)	0.09	6.8 (3.06)	0.05
	Overweight	9.46 (4.93)		6.03 (2.88)	
	Obese	6.96 (4.34)		7.75 (4.57)	
Potassium (mg)	Normal weight	2765 (1038)	0.36	2294 (995)	0.62
	Overweight	2870 (1591)		2148 (1068)	
	Obese	2404 (1786)		2244 (1134)	
Iodine (mg)	Normal weight	119 (80.4)	0.07	88.02 (66.44)	0.27
	Overweight	105 (60.47)		71.72 (48.05)	
	Obese	81.3 (52.31)		87.14 (118.47)	
Copper (mg)	Normal weight	1.27 (0.82)	0.26	1.47 (684)	0.71
	Overweight	1.28 (0.85)		0.87 (0.67)	
	Obese	0.97 (0.63)		0.9 (0.47)	
Selenium (mg)	Normal weight	60.43 (44.11)	0.74	42.78 (31.74)	0.11
	Overweight	62.61 (33.86)		33.82 (19.59)	
	Obese	54.55 (31.8)		39.67 (27.2)	
Na (mg)	Normal weight	2954 (1189)	0.2	2478 (1337)	0.11
	Overweight	3253 (1843)		2302 (1049)	
	Obese	2680 (966)		1985 (1108)	