Ellisras Longitudinal Study 2017: The relationship between dietary intake and body mass index among young rural adults in South Africa aged 18 to 30 years (ELS 18)

Julia TM Mashiane, Kotsedi D Monyeki, Andre P Kengne, Nkwana M Rosina, Mafoloa S Monyeki

Abstract

Aim: To assess the relationship between dietary intake and adiposity in young rural South African adults.

Methods: A total of 728 young adults participated and dietary intake was assessed using the 24-hour recall method. Linear regression models were used to determine the association between dietary intake and body mass index (BMI) before and after adjustment for age and gender.

Results: Females showed higher mean BMI values than males in all age groups. An age group of 27- to 30-year-old females had a mean value of 28.1 kg/m^2 while males had a mean value of 21.9 kg/m^2. The distribution of BMI categories (underweight, normal weight, overweight, obese) was 20.5, 61.7, 9.3 and 3.1% in males, and 8.6, 42.5, 23.1 and 25.8% in females ($p \leq 0.05$). Cholesterol intake was significantly ($p \leq 0.05$) associated with BMI (beta = 0.002, 95% CI: 0.00–0.004) as well as overweight and obesity (odds ratio = 1.734; 95% CI: –1.09–2.75) after adjustment for age and gender.

Conclusion: There was a high prevalence of overweight and obesity among rural Ellisras females. Moreover, increasing cholesterol intake was associated with overweight and obesity in the overall sample.

Keywords: dietary intake, body mass index, adults, overweight and obesity

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The prevalence of obesity continues to increase at an alarming rate worldwide, with approximately two billion people being overweight and one-third of them obese.[1] Over-consumption of macronutrients contributes to overweight and obesity among the adult population.[2] A diet characterised by a decrease in dietary fibre and an increase in saturated fats, accompanied by a lack of physical activity, results in weight gain.[3,4] This is the result of a positive energy balance, where energy intake is higher than energy expenditure.[2]

Traditional eating habits of South Africans residing in rural areas consist mostly of a prudent diet, which is associated with a low prevalence of overweight and obesity.[5-8] However, the shift towards a Western diet has become apparent among rural Africans, increasing their likelihood of having modifiable risk factors for chronic diseases of lifestyles, which include physical inactivity, increased alcohol consumption, stress and smoking.[5]

Preliminary results from the Ellisras cohort study showed a significant association between intake of mono-unsaturated fats and body mass index (BMI) among rural Ellisras children.[9] Furthermore, Sekgala *et al*.[10] reported a potential link between dietary fibre intake and fasting blood glucose and high-density lipoprotein cholesterol levels with both systolic and diastolic blood pressure among young rural Ellisras adults. With the Ellisras sample reaching the young adult stage, the relationship between BMI and dietary intake has received little attention. This cross-sectional study aimed to investigate the relationship between dietary intake and BMI among young rural Ellisras adults aged 18 to 30 years.

Methods

This study is part of the ongoing Ellisras longitudinal study (ELS), of which the details of the sampling procedure and geographical area were reported elsewhere.[11] The subjects participating in this cross-sectional study included 728 young adults (356 males and 372 females), aged 18 to 30 years, who are part of the Ellisras longitudinal study (ELS).

The ethics committee of the University of Limpopo granted ethical approval prior to the survey. The participants were provided with informed consent forms and signed the form after receiving verbal assent from the project leader.

All participants underwent a series of anthropometric measurements according to the standard procedures recommended by the International Society for the Advancement of Kinanthropometry (ISAK).[12] Weight was measured on an electronic scale to the nearest 0.1 kg, with light clothing and without shoes. Martin anthropometric was used to measure height, to the nearest 0.1 cm, with no shoes. BMI was defined as weight (kg)/height (m^2). All participants were classified as underweight, normal, overweight and obese, according to World Health Organisation cut-off points for adults.[13]

Department of Physiology and Environmental Health, University of Limpopo, Sovenga, South Africa
Julia TM Mashiane, BSc (Hons)
Kotsedi D Monyeki, PhD, MPH, kotsedi.monyeki@ul.ac.za
Nkwana M Rosina, BSc (Hons)
Mafoloa S Monyeki, MPhil

Non-Communicable Diseases Research Unit, South African Medical Research Council and University of Cape Town, Cape Town, South Africa
Andre P Kengne, MD, PhD, CRENC

Diet was measured using the 24-hour recall method, which is a valid method to determine group dietary intake.[14] In December 2015, senior Northern Sotho-speaking dietetics students of the University of Limpopo, specifically trained in using the 24-hour recall method, interviewed the parent/caregiver at home regarding the dietary intake of the young adults over the previous 24 hours. For each participant, an interview took place on one weekday and one weekend day. An average of two days of 24-hour dietary intake was then taken for each participant.

Estimated portion sizes of foods consumed were recorded in as much detail as possible, using a pre-tested questionnaire and food models simulating average portions of local foods.[15,16] Dietary data were analysed using local food tables and Food Finder dietary software, and compared with recommended intakes.[15-18]

Statistical analysis

Variables were summarised as descriptive statistics. Linear regression models were used to assess the continuous association between dietary intake and BMI, while logistic regression models were used to assess the association between low/high dietary intake and prevalent overweight and obesity, both in invariable analyses and after adjusting for age and gender. All data were analysed using the statistical package for social sciences (SPSS) version 23 and a p-value < 0.05 was used to characterise statistically significant results.

Results

The mean BMI was 20.3–21.9 kg/m² in males and 23.2–28.1 kg/m² in females ($p \leq 0.05$). Mean BMI increased from 20.3 kg/m² in the age group 18–20 years to 21.9 kg/m² in the age group 27–30 years in males, and from 23.2 to 28.1 kg/m² in females (Fig. 1).

The distribution of BMI categories in the overall sample was 8.6–20.5% for underweight, 9.3–23.1% for overweight and 3.1–25.8% for obesity. Equivalent figures were 20.5, 61.7, 9.3 and 3.1% in males, against 8.6, 43.5, 23.1 and 25.8% in females ($p \leq 0.05$ for the difference in the distribution of BMI categories in males and females) (Fig. 2). Males had a higher incidence of underweight (20.5%) than females. However, females (23.1 and 25.8%) showed a higher incidence than males (9.3 and 3.1%) of overweight and obesity, respectively.

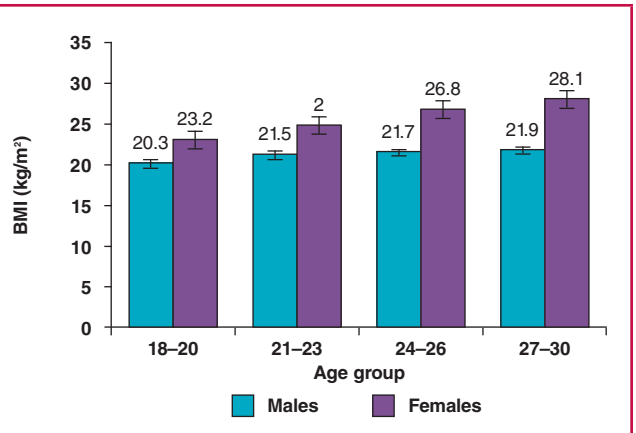

Fig. 1. Descriptive statistics of mean body mass index by age group and gender among young rural Ellisras adults aged 18–30 years.

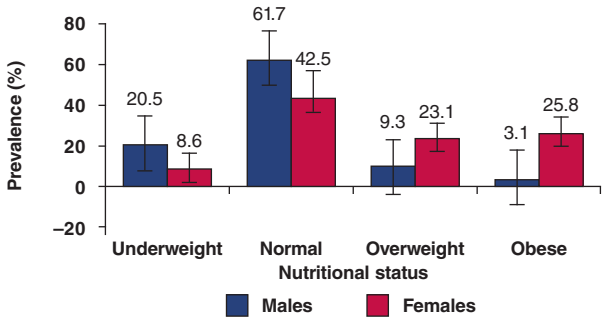

Fig. 2. The prevalence of malnutrition by gender among young rural Ellisras adults aged 18–30 years.

Fried chicken (23.8%), pap (22.6%), cold drink (16.9%) and white sugar (14%) were the foods most frequently consumed by the young Ellisras adults, while samp (2.6%), yogurt (2.4%) and spinach (2.0%) were the least frequently consumed foods (Table 1). Carbohydrates ranged between 78.2 and 84.5% while total fats and saturated fats ranged between 31.6 and 42%, and 4.1 and 6.0%, respectively, for all BMI categories for the overall population (Fig. 3).

In linear regression analyses, there was a borderline positive association between cholesterol intake and BMI ($p = 0.058$), with further enhancement after adjustment for age and gender (beta = 0.002, $p = 0.035$) (Table 2). Table 3 presents logistic regression for the association between overweight/obesity and low dietary intake. In logistic regression analyses, there was a positive association between cholesterol intake and overweight and obesity ($p = 0.084$), and after adjustment for age and gender, the association of cholesterol intake with overweight and obesity was significant ($p = 0.020$) (Table 3).

Discussion

This study aimed to investigate the relationship between dietary intake and BMI among young rural Ellisras adults aged 18 to 30 years. There was a significant association between cholesterol intake and BMI. Furthermore, a high prevalence was reported of overweight and obesity among females compared to males in the Ellisras population. These findings were in line with previous

Table 1. The most frequent food items in the diets for the overall sample, from the most common food liked to the least liked

Variables	*Percentage*
Fried chicken with skin	23.8
Pap	22.6
Cold drink	16.9
White sugar	14
Vetkoek	5.8
Fried beef	4.7
Peanut butter	4.4
Samp	2.6
Yoghurt	2.4
Spinach	2.0
Pilchards	0.5

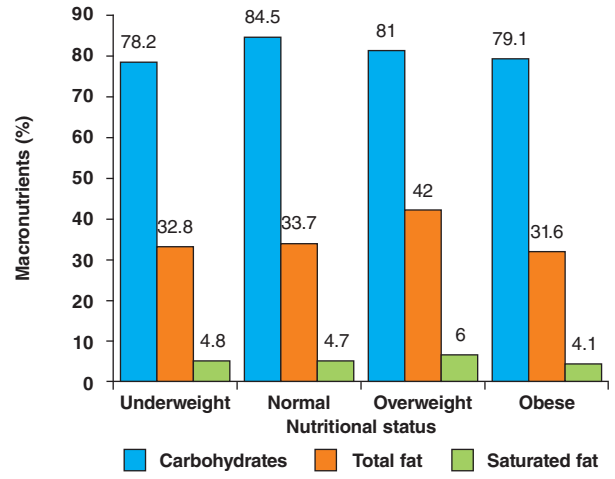

Fig. 3. Descriptive statistics for 24-hour recall of dietary intake by nutritional status of young rural Ellisras adults aged 18–30 years.

studies conducted in rural black communities in the Limpopo province.[3] This may be due to culture-related attitudes, physical inactivity, poor nutritional value of food, and high intake of calorie-dense food in rural populations.[3]

Obesity is a risk factor for cardiovascular diseases such as hypertension and type 2 diabetes, and it is a global public health concern.[13] Van Den Ende *et al.*[9] reported a low prevalence of overweight and obesity among the same sample at a younger age (7–15 years). The present study revealed a high prevalence of obesity (3–26%) and overweight (9–23%) as the ELS sample grew older. This is a serious concern.

The findings are in line with other studies in Africa and the prevalence of overweight and obesity continues to increase, with from 25 to 60% of urban females being overweight.[3,4] The influence of a Western diet together with low levels of physical activity, particularly among women, as reported by Sekgala *et al.*,[10] Mchiza *et al.*[6] and Jaffer *et al.*[7] among the South African population, could be contributing to this escalating high prevalence of obesity and overweight.

Table 2. Linear regression coefficient, 95% CI and *p*-value in the association with body mass index and dietary intake

	Unadjusted				*Adjusted (age and gender)*			
BMI variables	β	*95% CI*		p-*value*	β	*95% CI*		p-*value*
Total fat	–0.002	–0.011	0.007	0.665	–0.001	–0.010	0.007	0.738
Animal protein	0.000	–0.016	0.015	0.988	0.004	–0.010	0.018	0.538
Plant protein	–0.001	–0.041	0.038	0.951	0.008	–0.028	0.044	0.667
Total sugar	0.009	–0.010	0.028	0.366	–0.002	–0.019	0.015	0.827
Carbohydrates	0.001	–0.002	0.004	0.545	0.001	–0.002	0.004	0.459
Total dietary fibre	0.016	–0.040	0.073	0.570	0.019	–0.032	0.071	0.460
Total protein	0.000	–0.013	0.014	0.972	0.005	–0.007	0.017	0.451
Cholesterol intake	0.002	0.000	0.004	0.058	0.002	0.000	0.004	0.035*
Mono-unsaturated fatty acids	–0.008	–0.032	0.016	0.527	–0.005	–0.027	0.016	0.634
Polyunsaturated fatty acids	–0.002	–0.033	0.028	0.876	–0.002	–0.029	0.026	0.899
Saturated fatty acids	–0.007	–0.033	0.019	0.600	–0.007	–0.030	0.017	0.583

CI: confidence interval, β: beta-coefficient. *Significant at $p < 0.05$.

Furthermore, several studies have reported the over-consumption of macronutrients to be one of the leading causes of the high prevalence of overweight and obesity among the adult Saudi population.[19,20] An increase in urbanisation, in terms of social, political and economic factors, explains the dietary transition in South Africa among females.[21] It is projected that the population of overweight and obesity worldwide will increase to 2.3 billion for overweight and 700 million for obesity.[3] According to the Global Burden of Metabolic Risk Factors of Chronic Diseases Collaboration Group, 9.1 million adults are affected with overweight and obesity.[22] This has caused the tendency of overweight and obesity to double worldwide.

The intake of carbohydrates and fats in the present study was higher than that reported by Van Den Ende *et al.*[9] in the same sample at a younger age. Singh *et al.*[2] recommended 60% carbohydrate, 30% total fats and 10% protein as the total daily kilocalories for an individual. The high consumption of fats in our study therefore reveals that there is a peak in the nutritional transition, and weight status has therefore changed among Ellisras females. The high intake of saturated fat reported in this study is in agreement with that in healthy young adults in Saudi Arabia.[23]

The significant association between dietary intake and BMI predicts that the higher the percentage of kilojoules, the higher the risk of overweight and obesity. This finding is consistent with Van Den Ende *et al.*[9] Sengwayo *et al.*[3] found a significant association of dyslipidaemia with high BMI among females in Limpopo. This is associated with a shift in the nutritional pattern, which predisposes to the development of atherosclerosis due to a high cholesterol intake.

A limitation of this study is the cross-sectional design, which does not allow an analysis of cause and effect regarding the association between BMI and dietary intake. Also we did not consider blood sample analysis to support the findings of dietary intake. However, Steyn *et al.*[21] confirm that dietary intake can be reliably evaluated by assessing the macronutrient intake. All anthropometric data were measured, not self-reported by the participants, which allows the comparison of our study with other studies in South Africa to be accurate.[4,21] Furthermore, we used interviewer-administered questionnaires, which are more effective than a self-administered questionnaire.[5]

Conclusions

There was a high prevalence of overweight and obesity among rural Ellisras females. Cholesterol intake was associated with a

Table 3. Logistic regression for the association between overweight/obesity and low dietary intake

	Unadjusted				*Adjusted for age and gender*			
Variable	*OR*	*95% CI*		*p-value*	*OR*	*95% CI*		*p-value*
Overweight/obesity								
Total fat	0.78	0.56	1.10	0.154	0.86	0.59	1.22	0.430
Total sugar	1.18	0.67	2.08	0.561	0.96	0.52	1.78	0.900
Saturated fat	1.23	0.89	1.69	0.215	1.32	0.924	1.894	0.127
Mono-unsaturated fat	0.61	0.20	1.88	0.388	0.48	0.14	1.694	0.255
Polyunsaturated fat	1.48	0.25	8.93	0.668	1.46	0.20	10.81	0.708
Cholesterol intake	1.43	0.95	2.16	0.084	1.73	1.09	2.75	0.020*

OR: odds ratio; CI: confidence interval. *Significant at $p < 0.05$.

raised BMI in the overall sample. Therefore, dietary knowledge and access to resources are important to improve health and nutrition in a sustainable way. The need to assess the changes that occur over time in serum levels of a variety of biochemical and haematological parameters related to cardiovascular diseases and/or diabetes in rural African settings is vital.

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