Assessing Food Intake and Footstep Counts among Secondary School Girls in Oman

Zuwaina Humaid AL-Mahrouqi[1]

ABSTRACT

Introduction: Obesity is a growing trend among Omani adolescent girls but there is a dearth of data. The current study aimed to quantitatively measure the dietary habits and activity levels of Omani adolescent females in a semi-rural Omani town.

Material and methods: The dietary and activity patterns of 59 Omani schoolgirls aged 15–18 years were studied using 7-day un-weighed diet diary and pedometer. After eliminating the data of diet-diary mis-reporters, the data of 33 (56%) normal reporters were processed further.

Results: The mean energy consumption, at 1,681 Kcal, was much less than the recommended 2,400 Kcal/day. Normal weight girls obtained their energy from proteins 13%, carbohydrates 53%, and fats 33%, The corresponding figures for overweight girls were 13%, 54%, and 32%, and for obese girls these were 13.5%, 54%, and 32%. The mean daily footsteps taken by the entire cohort was 5,755, compared to the recommended 10,000 - 11,700. Normal weight participants averaged 6,625 steps/ day, followed by the overweight at 6094, and the obese, at 4011.

Conclusion: Significant differences between BMI groups were observed in activity levels rather than food consumption patterns. This calls for policy makers to add more physical activity in girls' schools, and educate both parents to encourage physical activity among their daughters.

Keywords: Adolescent Girls, Obesity, Overweight, Footstep Counts, Energy Intake

INTRODUCTION

For overall physical and mental health, World Health Organization recommends adopting a healthy lifestyle, the key components of which include regular balanced diet and optimal physical activity. A balanced diet comprises recommended proportions of the main five food groups—namely, carbohydrates, proteins, fats, vitamins, and minerals.[1] In the modern world the trend is to consume processed high energy, high fat foods, along with an inactive lifestyle indoors, made possible by modern technology. This has caused the rise in obesity worldwide, increasing the risk for non-communicable diseases such as hypertension, cardiovascular diseases, and diabetes mellitus.[2,3,4]

The obesity problem started first in the Westernized rich economies where it is showing signs of levelling off. In emerging economies such as the Arab world the trend towards obesity still growing. In the Arab world including Oman this has serious future complications due to the heavily youth-based demography because diet and inactivity related high BMI is found at younger.[5] This necessitates focusing on adolescents, particularly adolescent girls, as future mothers, whose dietary and activity behaviour will profoundly impact the next generation.

In Oman, where this study took place, there is a dearth of literature that assess food habits and physical activity of adolescents.[6] This study aims to reduce the data gap by quantitatively assessing the food intake (by means of diet diary) and physical activity (footstep counts) among secondary school Omani girls aged 15–18 years. This paper is based on a detailed mixed methods study conducted on the same cohort, but depicts only the quantitative findings of the study. The qualitative aspects, too detailed and complex to be featured in a single journal article, will be depicted in a separate research paper.

MATERIAL AND METHODS

The inclusion criteria were: Omani school girls aged 15–18 years, enrolled in 10–12 grades, free from physical disabilities, in good health, neither pregnant nor lactating, and free from medical conditions that restricted their diet or physical activity. Ethical approval was granted by the Oman Ministry of Education on the October 2015. The study was conducted during March–April 2016 among 15–18-year-old girls enrolled in two secondary girls' schools in Ibri, a semi-rural town in the interior of Oman.

Participants were randomly selected from school records using online randomiser software. Consent from participants and their parents were taken. A total of 59 participants maintained un-weighed 7-day diet diaries. Recording of food intake across seven days, including the weekends, was thought to reduce the bias toward certain days and help in assessing the most regular and irregular foods consumed. The participants' activity levels for these seven days were simultaneously measured using pedometers.

The body mass index (BMI) of each participant was calculated using their height and weight measurements, and the participants were classified thus: Underweight: BMI <18.5 kg/m^2; normal-weight: BMI 18.5-24.9 kg/m^2;

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overweight: BMI 25–29.9 kg/m^2; obese: BMI ≥30 kg/m^2.[7] Sedentary behaviour was taken <1.5 Metabolic Equivalents (METs) a day, as measured by the footsteps recorded by pedometer.[8]

A 7-Day Food-and-Drink Diary — a printed booklet in Arabic with 17 A4-sized pages — was developed by the researcher based on NetWisp 4 (Tinuviel Software) international diet diaries, custom-modified to include the local food types. Most foods and drinks displayed in the NetWisp programme were European, quite different from Omani traditional foods, in terms of type, ingredients, as well as nutrient and energy contents. The nutritional equivalents of common Omani food items not listed in the Netwisp 4 software were calculated using a custom-designed Microsoft Excel template.[9]

The participants were directed to record details of food and drinks they consumed, with time, quantity (using household measures such as tablespoons, teaspoons, bowls and cups), how food was prepared and brand name of the packed food items. They were instructed to keep their diary within reach all the time and record any intake promptly to avoid forgetting. Researcher reminded the participants not to change their food habits during this one-week period but follow their usual routine.

For measuring activity, pedometer model (model SW-701) was used on all participants. Each unit was pretested by the researcher and calibrated to the respective wearer's body weight. Each participant was to clip her pedometer to either a belt or waistband on the anterior midline of her right or left thigh and to wear it for seven days continuously, except for bath or sleep. The participants were asked to maintain their usual activity routines and levels.

Identifying misreporting

After computing the total daily intake of carbohydrate, protein, fats and total daily Energy Intake (EI) as recorded in all 59 participants' diet diaries, these were examined for indications of misreporting of food intake[10] as per the following procedure:

Basal Metabolic Rate (BMR) of each participant was calculated using the Henry equation, BMR = (9.4 × participant's weight) + (249 × participant's height) +462.[11] BMR value was multiplied by Physical Activity Level (PAL) factor of 1.2 to obtain Total Energy Expenditure (TEE).[11,12] The Energy Intake (EI) as computed from the participant's diet diary was divided by the estimated TEE.[13,14] Using Goldberg cut-off, the participants whose EI: TEE ratios were in the range 0.76–1.24 were classified as "normal-reporters".[14] Those whose EI: TEE ratios fell below or above that range were "under-reporters" and "over-reporters" respectively, and their data excluded from the study.

The nutritional analysis of each normal reporter's un-weighed 7-day Diet Diary for total energy intake (fat, protein, and carbohydrate) was calculated using NetWisp 4 programme and Microsoft Excel 2010. All data were further analysed by SPSS version 23. Comparison of different nutrients taken from the un-weighed 7-day diet diaries data was performed according to the recommended dietary intake with The Omani Guide of Healthy Eating for girls aged 15–18 years.[15] The data that were found to be normally distributed were run through univariate analysis of variance or one-way ANOVA, to test the differences of mean across the three BMI groups. One-sample t-tests were conducted between reported nutrient intakes, daily step counts and recommended intakes, and daily step counts for this population group. The cross-tabulation analysis accompanied by chi-square tests for independency was performed to find the differences between BMI group and food intake and daily step counts. Statistical significance was assumed at P <0.05.

RESULTS

Dietary Intake Analysis from Un-weighed 7-day Diet Diary

Data were collected from 59 participants aged between 15 and 18 years who had completed the un-weighed 7-day diet diary. Of the 59 participants, 33 (56%) participants were classified normal reporters, 22 (37%) as under-reporters and 4 (7%) over reporters (table 1). On a daily basis, all the participants who completed the 7-Day Diet Diary had energy intakes less than the recommended 2,400 Kcal/day (Table 2). The WHO z-score chart was used to classify the BMI of each participant (Table 2). The BMI of these participants ranged from normal weight to obese (17.7–45.5 kg/m^2). There was no underweight participant in this cohort.

The 33 normal reporters' dietary data were compared to The Omani Guide to Healthy Eating. It was found that the mean consumption of carbohydrates and fats was below the recommended levels, while that of proteins was adequate (Table 3). A one sample t-test was conducted to examine whether the reported EI, carbohydrate, protein and fat could have been created by a probability distribution with a mean of the daily recommended 2,400 kcal, 390 g, 54 g and 70 g, respectively. The results are shown in Table 4.

Comparative intake of food groups between BMI Groups

One-way ANOVA indicated no significant differences. On the contrary, there was striking similarity in consumption patterns of various food groups between the three BMI groups. Normal weight girls obtained their energy from proteins 13%, carbohydrates 53%, and fats 33%, The corresponding figures for overweight girls were 13%, 54%, and 32%, and for obese girls these were 13.5%, 54%, and 32%.

Physical Activity Analysis (Pedometer)

The mean daily footsteps taken by the entire cohort was 5,755, much lower than the recommended 10,900 steps. The three BMI groups differed significantly in terms of daily footsteps (P<0.001). Normal weight participants averaged

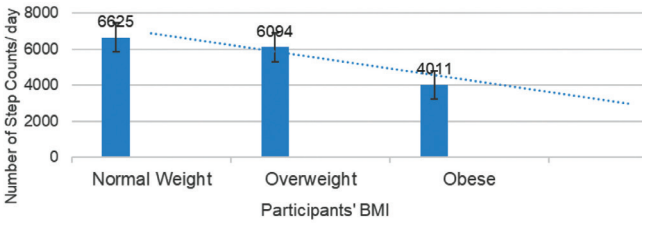

Figure-1: Average of Footstep Counts in different BMI Groups

Variable	Number	Normal weight	Obese	Overweight
Normal Reporter (0.76–1.24)	33 (56%)	19 (32%)	7 (12%)	7 (12%)
Under-Reporter (<0.76)	22 (37%)	6 (10%)	10 (17%)	6 (10%)
Over-Reporter (>1.24)	4 (7%)	4 (7%)	0 (0%)	0 (0%)
Total	59 (100%)	29 (49%)	17 (29%)	13 (22%)

Table-1: Frequencies and Percentages of Food Reporters

Variables	Categories	Number	%	Mean (*SD)
Age	15 years	13	22	16 (0.84)
	16 years	26	44	
	17 years	16	27	
	18 years	4	7	
Total		59	100	
**BMI (kg/m2)	Normal Weight	29	49	27 (7)
	Overweight	13	22	
	Obese	17	29	
Total		59	100	

*SD= Standard Deviation, **BMI= Body Mass Index, Kg=kilogram, m2= square meter

Table-2: Participants' Characteristics

Variable	Recommended (MOH 2009)	Number	%
Energy Intake (*Kcal/day)	<2,400	33	100
Protein Intake (**g/ day)	48–60 g	12	36
	<48 g	10	30
	>60 g	11	33
Carbohydrate Intake (**g/day)	<330 g	33	100
Fat Intake (**g/day)	<70 g	26	79
	>70 g	7	21

*Kcal= kilocalorie, **g= gram

Table-3: Frequencies and Percentages of Reported Dietary Intakes of Normal Reporter

Variable	Mean	*SD	mu	t	p
Energy Intake (*Kcal/day)	1,681	262	2,400	–15.77	< 0.001
Carbohydrate **g/ day	240	45	390	–18.92	< 0.001
Protein **g/ day	55	10	54	0.69	0.496
Fat **g/day	61	13	70	–4.20	< 0.001

Note: Degrees of Freedom for the t-statistic = 32. *Kcal= kilocalorie, **g= gram

Table-4: One Sample t-Test for reported Dietary Intake N=33

6,625 steps/ day, followed by the overweight at 6094, and the obese, at 4011 average steps (Figure 1). Independent samples t-test (P = 0.003), showed confirmed the significant differences between the BMI categories.

DISCUSSION

In the present study, despite the detailed instructions given to the study participants on how to maintain the diet diary, all normal reporter participants reported lower daily energy intakes (mean 1,681 Kcal), much less than the recommended 2,400 Kcal/day. Lower-than-recommended energy intake (1,651 kcal/ day) has also been reported among the majority (68%) of Palestinian adolescent girls in a study.[16] Whereas, British normal weight (11–18 years) and Ghanaian children (11–15 years) consumed higher daily energy (2,251 kcal and 2,074 kcal, respectively) than the present study participants'.[17,18]

Regarding carbohydrate intake, the present study participants' daily average was 240g, and almost the same as that of British adolescents' 243g.[17] However, significantly higher figures were reported by Ghanaian adolescents (294 g).[18]

In the current study, the average daily protein intake was 55g, higher than the recommended 48g, However, 30% girls consumed less protein than recommended. Higher average daily protein intakes were reported by British adolescents (67g) and Ghanaian adolescents (76g).[17,18] Jildeh et al.[16] revealed that 48% of the Palestinian adolescent girls consumed daily proteins less than the recommended value of 44 g of proteins per day.

In this present study, 21% of the participants reported higher dietary fat intake than the recommended 70 g/ day. Whereas, Jildeh et al.[16] reported a high prevalence of dietary fat consumption among male Palestinian adolescents (40%)

and female (30%) higher than the recommended total dietary fat intake which is <30%, higher that reported in this study. The average daily fat intake was 61 g, in the present study, less than that of British adolescent normal energy reporters (69 g) and Ghanaian adolescents (71 g).[17,18] This may be because of the colder climates increases the body's perceived need for more fat for insulation and as a more efficient source of energy than carbohydrate.[19] However, in terms of contribution to overall energy intake this study reported the energy gained from fat was 33%, nearly matching that of British adolescents (34%) and Danish adolescents (34%).[17,20]

The findings of the present study of daily energy intake and macronutrients revealed no significant differences between the participants in different BMI groups. However, a study reported by Albar et al. 19 found that normal weight British adolescents had significant higher daily energy intake (2,251 kcal) than overweight/ obese participants (1,633 kcal). Additionally, Harahap et al.[21] reported that Indonesian school age, overweight children consumed a higher mean of daily energy intake (1,381 kcal) when compared to their normal weight peers (1,185 kcal). On the other hand, normal weight Palestinian adolescents of both genders consumed a significantly higher mean of daily energy intake (2,016 kcal) than obese participants (1,541 kcal).[16] Palestinian boys consumed significantly higher daily energy (2,158 kcal) compared to girls (1,651 kcal).[16] However, the incidence of obesity and overweight among Palestinian boys was lower (30%) than girls (39%), which might be because 29% Palestinian boys performed physical exercise five days or more weekly compared to 16% girls.[16]

In the present study the normal reporters' energy intake was in the form of 13% protein 54% carbohydrate, and 33% fat. Similar results were yielded from a Turkish study on 970 girls aged 12–17[22] who completed self-reported 3-day diet diary. Flemish boys reported higher energy from protein (15%) and fat (36%), while their energy gains from carbohydrate were lower (49%)[23], than the Omani adolescents in this study. This may be because in colder climates the body seeks more fat for insulation and as the most efficient store of energy.[24]

The participants' physical activity levels were measured using pedometers for 7 consecutive days and the data presented as the mean of the number of footsteps per day. Most participants (98%) took average 5,755 steps per day against the recommended 10,000–11,700 steps for 10–18-year-olds.[12] Within that, the daily footstep counts of most obese participants averaged <5,000, while the normal weight participants achieved ≥ 5,000. As there was no guideline related to the optimum daily footsteps for Omanis, the recommended value by Tudor-Locke et al.[12] for girls between 10–18 years of age was used. Gordia et al.[25] indicated that a universal footstep count reference may not be applicable for adolescents in all countries or regions, therefore guidelines for adolescents recommended footstep counts may be needed to be tail or made for Omanis.

In the current study, the pedometer data indicated that normal weight participants clocked the highest mean footstep counts of 6,625 per day, which fell to 6,094 in the overweight girls, falling further to 5,755 for their obese peers. Such inverse relationship between footstep counts and BMI is reported by several international studies in various age groups. A large Saudi Arabian study on 2,908 participants aged 14–19-years (1,507 girls) studying in city schools revealed an average 6,866 step counts/ day,[26] 16% more than the current study's mean of 5,755 steps. The better performance by Saudi teens may be attributed to their living in large, cosmopolitan cities (Al-Khobar, Jeddah, and Riyadh). In addition, the Saudi study population comprised private and government school students while the present participants were all government-school students in the semi-rural Omani town of Ibri with less facilities.

The performance gap between Omani and Western girls was even wider. A large Canadian study that used accelerometers found girls aged 15–19 manage 9,204 steps/ day.[27] However, even the Canadian girls fell short of the recommended number of daily steps of 10,000–11,700.[12] The significantly low activity levels of Omani girls cannot be attributed to unfavourable climate because the study was conducted during Spring when the outside day temperature was comfortable — in the low 30 Celsius range with low humidity. The reasons for the relatively fewer steps taken by Omani teenagers of all BMI levels, need to be investigated.

As there was no guideline related to the optimum daily footsteps for Omanis, the recommended value by Tudor-Locke et al.[12] was used. As a universal footstep count reference is not applicable for adolescents in all countries or regions, which calls for developing guidelines for the Arabian Peninsula.

CONCLUSION

This study identifies sedentary behaviour to be the major reason for the prevalence for overweight and obesity among Omani female adolescents, in view of their lower-than-recommended energy intake across BMI groups. The diet diaries of normal reporters showed no significant differences between the participants across BMI groups in daily intake energy, macronutrients and the percentage of energy gained from macronutrients. Genetic and environmental reasons for obesity, as well as cultural, social and climatic factors that discourage physical activity among Omani females are beyond the scope of this article.

Even though this study was conducted in 2016 with a small sample of participants in a single town, this was the first study that quantitatively measured female adolescent BMI trends by mapping their diet habits using 7-day diet diaries customised for Oman, supplemented by activity levels measured by pedometer. Adolescent BMI trends are dynamic in nature, and in the Arab world, fast growing. Therefore, studies conducted during different years will give future researchers a better sense of the trend and nature of the problem. This is what this pioneering study has achieved. Future research could include employing weighed 7-day diet diaries to assess adolescents' energy intake will which would provide more accurate energy intake reporting. Regarding measuring the activity levels, a national or Arabian standard

has to be generated as to the optimum daily steps. The study can be expanded by enrolling both genders and age group from 12 years to 18 years to involve early adolescents in assessing their lifestyle and to explore differences between genders. Similar studies need to be conducted in different regions of Oman.

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