The prevalence of abdominal obesity and its associated risk factors in married, non-pregnant women born and living in high altitude, southwestern, Saudi Arabia

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ABSTRACT

Objectives: To determine the prevalence of abdominal obesity and it's associated risk factors in a married, non-pregnant, high altitude female population.

Methods: A cross-sectional study conducted from January to March 2003, with 438 currently married non-pregnant women aged 18-60 years, born and permanent residents in and around Abha, southwestern heights, Kingdom of Saudi Arabia. A questionnaire describing the demographic, social, reproductive, physical activity, and educational status was completed. The subjects were measured by weight, height, and waist circumference (WC). Body mass index (BMI) was calculated for each woman (BMI=weight [Kg]/height [m^2]). Abdominal obesity was defined as WC>88cm, and total obesity as BMI≥30 according to the World Health Organization criteria.

Results: The overall prevalence of abdominal obesity was 41.1%. The prevalence was positively and significantly associated with age, total obesity, and parity (p=0.0001 for all), negatively and significantly with educational level (p=0.0001), and negatively and insignificantly with strenuous physical activity (p=0.9). Results of multiple logistic analyses showed that age, total obesity, and educational level were independent risk factors for abdominal obesity.

Conclusion: The study highlighted the high prevalence of abdominal obesity and showed that in addition to total obesity, intra-abdominal fat deposition is influenced by other lifestyle and reproductive factors. Community health education programs, which provide information on the high prevalence of abdominal obesity and its risk factor to all women, will be certainly justifiable, and prevention strategies should be implemented accordingly.

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Distribution of body fat is known to be a more independent and potent predictor of morbidity,[1,2] and mortality[3,4] than total adiposity. In particular, abdominal obesity is associated with adverse changes in glucose tolerance and insulin resistance, blood lipids and lipoproteins, and blood pressure.[1,2,5] The connection of abdominal adiposity with these metabolic disturbances was thought to be due to the enlarged visceral fat depots discharging bioactive substances, including free fatty acids and proinflammatory mediators into the portal and systemic circulation, resulting in hyperinsulinemia and dyslipidemia.[6-8] Accurate assessment of abdominal obesity is not easy, and requires the use of imaging techniques, such as computed tomography[9] and magnetic resonance.[10] However, these techniques are expensive and hazardous to health, therefore, they are not suitable for large scale epidemiologic surveys. Hence, non-invasive anthropometric surrogates such as waist circumference (WC) and waist-to-hip ratio (WHR) are commonly employed.[11] Though the etiology of abdominal obesity is common in the world, the process of the development of abdominal obesity varies in different populations, which have culturally, socioeconomically, and environmentally different backgrounds. In the Kingdom of Saudi Arabia (KSA), only a few studies address the problem of abdominal obesity.[5,12-14] Except for one study conducted on elderly people,[13] none of the studies have dealt specifically with the southwestern heights where environmental factors differ widely from the other studied areas. The topography of the southwestern heights varies from an altitude of 2500-3150 meters above sea level, therefore, unlike other areas of KSA, they are characterized by cold weather, especially during winter, and low oxygen tension in the atmosphere.[15] The present study was carried out to determine the prevalence of abdominal obesity and the associated risk factors in currently married non-pregnant women born and living permanently in the southwestern heights of KSA.

Methods. The study was conducted from January to March 2003 in Abha city, southwestern heights, KSA (altitude: 2800-3150 meters above sea level, barometric pressure: 550-590 mmHg, winter temperature: 5°- 15°C, and summer temperature: 16°-28°C).[15] Abha is the capital of Aseer region, 600 km south of Jeddah (the second largest city in KSA). Five health centers were selected for this study, one in Abha and 4 around it. The health centers were run by qualified physicians who used a central referral hospital with good access roads. The data were obtained from 438 non-pregnant married women, aged 18-60 years. The local people working in the health centers were instructed to recruit all non-pregnant women registered in the 5 health centers. The inclusion criteria were currently married non-pregnant Saudi women, born and permanent residence in the area of study, and who did not have pathological conditions by clinical examination (chronic renal, respiratory, cardiovascular, endocrine, and gastrointestinal). Using the World Health Organization manual for sample size determination in health studies,[16] the minimal sample size required for the study was calculated to be 545 cases. A total of 662 women were recruited (85% of the total number of non-pregnant women registered in the 5 health centers), 224 were excluded for not fulfilling the criteria for inclusion. Excluded were single women (173), divorcees and widows (21), and women with chronic pathology (30) (mainly diabetics). The chosen centers around Abha city are essentially urbanized, primary health care centers. The vast majority of the population commute into Abha city for work, have modern amenities including potable water and electricity, and an adequate diet comprising mainly meat, chicken, and rice. All interviews and measurements were made in the health centers by a well-qualified nurse after obtaining consent from each participant. Approval to conduct the study from the Health Affairs of Aseer region was obtained.

A detailed questionnaire dealing with socio-demographic profile (age, reproductive data, physical activity, and level of education) was completed by each woman. Body weight was measured and recorded using an Avery Beam weighing scale to the nearest 0.1 Kg. Women were weighed partly dressed, and a correction of 0.5 Kg was made for clothing. Standing height was measured and recorded to the nearest 0.5 cm with stadiometer (without shoes). The WC was measured to the nearest 0.1 cm at the mid-point between the bottom of the rib cage and above the top of iliac crest by a flexible tape. Body mass index (BMI) was computed from the weight and the height (BMI=weight (Kg)/height (m^2). Abdominal obesity was defined as WC greater than 88 cm, and total obesity as BMI≥30.[11] Parity was defined as the number of pregnancies of 20 weeks gestation or more regardless of the outcome, and grand multiparity referred to the births of 5 or more viable infants. The Lipid Research Clinic questionnaire was used for the assessment of strenuous physical activity.[17] Women were asked to respond to the question "Do you regularly engage in strenuous exercise or hard physical labor?" If the response was positive the woman was asked, "Do you exercise or labor at least 3 times per week?" A positive response to this question classified a woman as regularly strenuous. A negative response to the first question classified a woman as non-strenuous, while a positive response to the first question and a negative response to the second question classified a woman as infrequently strenuous. Regularly strenuous women were given a score of 6 on an arbitrary 6-point scale, a score of 4 was given to infrequently strenuous women, and 2 were allocated to non-strenuous women. Education was categorized into 6 levels (0-5) corresponding to illiterate, read and write, primary school, intermediate school, secondary school, and university. To determine the effect of age on the prevalence of abdominal obesity, women were divided into age groups 18-39, and 40-60 years.

At different stages of the study, the collected data were compiled and fed using the Statistical Package for Social Sciences version 10, for the statistical analysis. Descriptive data were presented as mean±SD or percentage, Student's t-test was used to compare between 2 means, and Chi-square test to compare between 2 percentages. The relationship between each potential risk factor and abdominal obesity was estimated using Chi-square test and correlation analysis. Odd ratios (OR) were used to describe the effects of risk factors on abdominal obesity. In order to identify the independent predictors of abdominal obesity, binary logistic regression with the presence of abdominal obesity as dependent and potential risk factors as covariate was performed. In all cases, $p<0.05$ was considered statistically significant.

Results. **Table 1** shows some of the characteristics of the study population. Among the currently married non-pregnant women, the mean body weight, BMI, and WC increased significantly between the age groups 18-39 and 40-60 years ($p<0.0001$ for all), while the mean height remained constant between the same age groups. **Table 1** also shows that the women in the youngest age group attained a significantly higher educational level ($p<0.0001$), and reported slightly more but insignificant strenuous activity ($p<0.4$) than women in the oldest age group. The mean parity was significantly higher among women in the oldest group compared to women in the youngest age group ($p<0.0001$). Using the WC as an indicator for abdominal obesity, and BMI for total obesity, 41.1% were found to be abdominally obese, and 52.2% were totally obese. The prevalence of abdominal obesity increased significantly from 31.8% in women aged <40 years to 62.4% in those age ≥40 years (trend, $X^2=35.8$, $p<0.0001$). Age was also found to be positively and significantly correlated with abdominal obesity (r=0.34, $p<0.01$), and those aged ≥40 years were more at risk of developing abdominal obesity (OR, 95% CI 3.56 [2.33-5.45]). Total obesity was positively and significantly correlated with abdominal obesity (r=0.48, $p<0.01$), and the prevalence of abdominal obesity increased from 15.9% in lean women to 63.9% in the totally obese ($X^2=104.2$, $p<0.0001$). Total obesity increased the risk for abdominal obesity by 9.39 (95% CI, 5.93-14.86, $p<0.0001$). An insignificant negative correlation between strenuous activity score and abdominal obesity was observed (r=-0.05, $p<0.3$). The trend analysis showed that the prevalence of abdominal obesity was not significantly different between the 3 activity scores ($X^2=0.96$, $p<0.6$) although the highest proportion of the abdominally obese women were found in the non-strenuous group and the lowest proportion were in the regularly strenuous group (**Table 2**). Parity was found to be positively and significantly associated with abdominal obesity (r=0.29, $p<0.01$), and the prevalence of abdominal obesity increased between the 3 parity groups (trend, $X^2=24.2$, $p<0.0001$) (**Table 2**). Parity increased the risk for abdominal obesity by 2.02 (95% CI, 1.03-3.93). **Table 2** also shows the prevalence of abdominal obesity according to the level of education. The prevalence decreased from 54.1% in illiterate women to 29.6% in educated ones. The trend analysis showed that the prevalence was significantly different between the 6 educational levels ($X^2=44.6$, $p<0.0001$) and decreased with increase in educational level (r=-0.31, $p<0.01$); and illiterate women had a higher risk for abdominal obesity (OR, 95% CI 2.81 [1.89-4.17]). Binary logistic regression with abdominal obesity as dependent and potential risk factors (total obesity, age activity score, parity, and educational level) as covariate revealed total obesity, age, and educational level as the significant independent predictors of abdominal obesity (**Table 3**).

Discussion. The present study determined the prevalence of abdominal obesity in a high altitude female population, and showed that the prevalence increased significantly with increase in age, total obesity, and parity, and decreased significantly with increase

Table 1 - The distribution of weight, height, waist circumference (WC), body mass index (BMI), parity, activity score, and educational level by age. All values are expressed as mean±standard deviation.

Age (years)	18 - 39	40 - 60	18 - 60
N	305	133	438
Weight (Kg)	69.4±14.4	75.8±14.0*	71.3±14.6
Height (cm)	152.9±7.1	152.9±5.6†	152.9±6.7
WC (cm)	81.3±16.4	90.7±13.5*	84.2±16.1
BMI (kg/m2)	29.8±6.5	32.4±5.9*	30.6±6.5
Activity score	2.78±1.53†	2.65±1.43	2.74±1.50
Parity	3.9±2.8	7.7±3.4*	5.1±3.5
Educational level	1.9±1.6*	0.4±1.0	1.5±1.6

*$p<0.0001$, †not significant

Table 2 - The prevalence of abdominal obesity according to strenuous activity, parity, and educational level.

Factor	n (%)	Abdominally obese n (%)
Activity score		
2	348 (79.5)	147 (42.2)
4	18 (4.1)	7 (38.9)
6	72 (16.4)	26 (36.1)
Parity		
0	48 (11)	13 (27.1)
1 - 4	152 (34.7)	44 (28.9)
≥5	238 (54.3)	123 (51.7)
Educational level		
0	205 (46.8)	111 (54.1)
1	39 (8.9)	22 (56.4)
2	70 (16)	22 (31.4)
3	55 (12.6)	14 (25.5)
4	53 (12.1)	8 (15.1)
5	16 (3.7)	3 (18.8)

Table 3 - Logistic regression model showing coefficients (B), *p* value, adjusted Odds ratio (aOR), and 95% confidence interval (CI) of age, level of education, and total obesity in developing abdominal obesity.

Variable	B	*p*-value	aOR	95% CI
Age	0.04	0.006	1.04	1.01-1.07
Level of education	-0.22	0.02	0.81	0.67-0.97
Total obesity	2.10	0.0001	8.14	5.02-13.18

in educational level, and insignificantly with increase in strenuous physical activity. The WC was chosen to assess abdominal obesity as it is easy to measure, and the measurement error is low due to large circumference. More importantly, WC is highly correlated with visceral adipose tissue accumulation.[18,19] The WHR was not used due to the inherent weakness as a ratio index,[20] and is strongly influenced by pelvic structure.[21] The lipid research method[17] was selected as a measure of strenuous physical activity as it is short and easy to administer in surveys, which assesses both occupational and leisure activity. In addition, the method appeared to be related to measures of fitness, as well as disease risk factors.[22] Moreover, this method has been validated for use in this population.[23]

The overall prevalence of abdominal obesity among non-pregnant married women, aged 18-60 years, born and living permanently at high altitude was found to be 41.1%. In a previous study on elderly women in southwestern Saudi Arabia, Abolfotouh et al[13] reported a prevalence of 29.2% using WC, and 34.9% using WHR, and in a recent community based national epidemiological study on metabolic syndrome, Al-Nozha et al[5] reported a prevalence of 55.4% among Saudi women aged 30-70 years. The reported prevalence from other countries varies. In the United States, Okosun et al[24] reported a prevalence of 43.2% in white, 56% black, and 55.4% Hispanic American women, and in an international epidemiologic study the prevalence was found to be 43% in Northwest Europe, 22% in southeast Asia, and 55% in south Asia.[25] Reports from other Arab countries showed a prevalence of 25% among Palestinian women,[26] 16.8% among Moroccan women,[27] and 44.3% among Omani women.[28] Studies from nearby non-Arab countries showed a prevalence of 38.9% among Turkish women,[29] and 56.9% among Iranian women.[30] This worldwide variation in the prevalence of abdominal obesity cannot simply be due to ethnicity, but may involve a wide range of genetic, socio-economic, environmental, and cultural factors.[25]

One consistent trend in the literature on abdominal obesity is the tendency to be more prevalent with increasing age.[24-29] This trend was apparent in this study. However, some studies showed a fall in the prevalence after the age of 60 years.[5] Abdominal adiposity is a potent risk factor for many diseases,[1,2] and the drop in its prevalence after the age of 60 years is a reflection of a better state of health beyond that age. The present study also showed that total obesity is strongly associated with abdominal obesity. This observation is in agreement with previous reports in the field.[31-33] It has been calculated that for every kilogram of adipose tissue added to the body, about 200 grams is added to the visceral adipose tissue store.[33]

No significant association was observed between strenuous activity and abdominal obesity, although the highest proportion of abdominally obese women were in the non-strenuous group and the lowest were in the regularly strenuous group. In other previous studies, physical activity was found to be negatively and significantly correlated with abdominal obesity.[29-31,34] The low levels of strenuous physical activity observed in women participated in this study may be related to socio-cultural and environmental factors. Due to the cold weather at high altitude and the topography of the area with its ups and downs, women tend to spend most of their time indoors looking after their homes and hardly any leisure activity is performed by housewives. In addition, the present female population was so homogenous with regard to physical activity, that it has little or no apparent effect on abdominal obesity between individuals. The lack of significant association between strenuous physical activity and abdominal obesity is, therefore, attributed to the low and homogenous levels of strenuous activity.

In this study sample, parity was found to be positively and significantly associated with abdominal obesity, an observation consistent with previous studies.[27,34,35] However, the relationship between parity and abdominal obesity is complex. Repeated pregnancies and lifestyle risk factors associated with child rearing (such as anxiety and stress) were shown to cause an increase in the intra-abdominal fats.[35] On the other hand, nulliparity is known to be associated with increased incidence of metabolic syndrome (including abdominal obesity)[35] and increased intra-abdominal fat has been demonstrated even in non-obese nulliparous women with polycystic ovary syndrome.[36] The relationship between parity and abdominal obesity is, therefore, not exactly linear but "J" shaped.[35] However, our results show insignificance difference between the prevalence of obesity among nulliparous women and women with 1-4 pregnancies (p<0.5) (**Table 2**).

A significant negative relationship was found between educational level and abdominal obesity. This finding is in accordance with previous studies from the developed[24] and the developing countries.[5,29] The mechanism by which the level of education influences abdominal obesity is poorly understood, and lies beyond the scope of this paper. It is the general understanding that lower educational level promotes high energy intake that results in obesity in developed countries, and higher educational level enables a high energy intake that results in obesity in developing countries.[37] Whatever the mechanism is, it would be reasonable to speculate that higher educational level enables women to lead a healthy life with regard to energy consumption and expenditure, and to be aware of the serious consequences of abdominal obesity on morbidity and mortality.

In conclusion, the results of the present study showed a high prevalence of abdominal obesity among Saudi women of the southwestern heights of the Kingdom and revealed that age, total obesity, parity, and educational level were significant risk factors while strenuous activity was insignificant for abdominal obesity. It also showed that age, total obesity, and educational level were independent risk factors and parity was a confounded factor for abdominal obesity. Health education programmes should provide information about the risk factors for abdominal obesity to all women, and preventive strategies should be implemented accordingly.

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