J HEALTH POPUL NUTR 2004 Mar;22(1):75-83
ISSN 1606-0997 $ 5.00+0.20

Assessment of Obesity, Lifestyle, and Reproductive Health Needs of Female Citizens of Al Ain, United Arab Emirates

Anne O. Carter[1], Hussain F. Saadi[2], Richard L. Reed[3], and Earl V. Dunn[3]

[1]School of Clinical Medicine and Research (Formerly with Department of Community Medicine, United Arab Emirates University), University of the West Indies, Cave Hill, Barbados, [2]Department of Internal Medicine, and [3]Department of Family Medicine, Faculty of Medicine and Health Sciences, Al Ain, United Arab Emirates University, United Arab Emirates

ABSTRACT

This study was conducted to determine the reproductive and lifestyle characteristics in a representative sample (n=535) of women in Al Ain, United Arab Emirates, to guide the development of health programmes for this population with rising affluence. A cross-sectional survey was carried out using the stratified two-stage sampling technique. Although most women were young, were pre-menopausal, did not smoke, reported good health status, and 84% (95% confidence interval [CI] 81-87%) reported being sufficiently active to meet expert recommendations, the prevalence of obesity (defined by body mass index ≥30) was very high (35%; 95% CI 31-39%) and many (28%; 95% CI 24-32%) reported having a chronic disease. The prevalence of obesity was associated positively with age and negatively with education ($p<0.001$ for both). Postmenopausal women had significantly more chronic diseases, reported poor health more often, were less physically active ($p<0.001$ for all), and had a higher percentage of body fat ($p=0.002$) compared to premenopausal women. Health services should emphasize the prevention and treatment of obesity and improving the general health status of postmenopausal women.

Key words: Obesity; Lifestyle; Women's health; Reproductive health; Cross-sectional studies; United Arab Emirates

INTRODUCTION

The United Arab Emirates (UAE), an Arabian Gulf state, has a population of 3.1 million, of whom only a small minority are citizens of the country, the remainder being expatriate workers and their families. The country has undergone rapid development over the last 30 years following the discovery of oil and the formation of the country from 7 emirates. A modern infrastructure has been established, and residents have undergone significant changes in lifestyle that parallel the rapid development of their country, including transition from deficiency diseases and undernutrition to degenerative diseases associated with overnutrition. These changes may lead to a rise in risk factors for chronic diseases and changes in reproductive factors in women. Establishing prevalences for such factors is essential for public-health planning (1), and planning must be done separately for men and women in Muslim countries, such as UAE, because strict sexual segregation is followed for most health programmes.

In developing countries, especially Muslim countries, population-prevalence studies are difficult, particularly

Correspondence and reprint requests should be addressed to: Dr. Anne O. Carter
School of Clinical Medicine and Research
University of the West Indies
Cave Hill, Barbados
Email: annecarter@uwichill.edu.bb or rwxrwx@lycos.com
Fax: 429-6738

for women, because of lack of access to a representative sample of community-dwelling people and reticence on the part of subjects to participate. These barriers can be overcome by using community survey techniques developed specifically for this purpose (2). We used such techniques to provide a representative sample of community-dwelling adult female citizens in Al Ain city, UAE, a small desert oasis city with about 300,000 people located in an agricultural district.

Only four studies have assessed the prevalence of risk factors for chronic diseases or reproductive factors among female citizens of UAE. Female citizens represented over half of the members of three communities studied in 1989-1990 for prevalence of obesity, diabetes, and hypertension (3) but other risk factors for chronic diseases and reproductive factors were not studied. This study showed a prevalence of obesity of 28% among women surveyed, a rate that prompts concern and identifies a need for further study. The UAE Ministry of Health performed two community surveys on child and family health in 1987 and 1995, which included some information on reproductive factors in women but did not look at lifestyle factors (4,5). In addition, one survey of postmenopausal women has been reported (6), but this survey included all residents, not just citizens, and did not look at lifestyle factors.

Since none of these studies provided adequate information to guide public-health planning for female citizens of UAE, the present study was conceived. The aim of this study was to establish the prevalence of various health-related lifestyle and reproductive factors among adult female citizens in Al Ain and to investigate their association with personal characteristics to guide health promotion and disease-prevention planning for UAE women.

MATERIALS AND METHODS

Approval for the study was obtained from the Research Ethics Committee of the Faculty of Medicine and Health Sciences, UAE University, UAE.

Study subjects

A random sample of community-dwelling female UAE citizens living in the urban area of Al Ain medical district was surveyed during September 2000–August 2001. The stratified sampling technique was chosen to allow for an efficient data-collection process. Certain areas of the city are set aside for citizens' residences, and non-citizens are restricted from living in these areas. Seventy-five such areas were identified, and 16 were selected randomly. The best available map of each area selected was used for identifying all streets in the area, and a predetermined number of streets were randomly selected based on the size of the area. Every third house on each selected street was visited up to a maximum of 10 houses. All female UAE citizens aged over 19 years in each household visited were eligible for the study. Since no published demographic data are available in which female citizens are specifically identified, the actual sampling frame of female citizens was unknown. Therefore, sampling ratios were chosen based on the investigators' previous experience with community surveys in this population to recruit approximately 500 subjects for the study. This number was calculated to be sufficient to produce 95% confidence limits for prevalence of less than 10% even if as many as 20% of responses were missing.

Questionnaire

Following informed consent, a trained healthcare worker interviewed each eligible subject in Arabic using a questionnaire in Arabic. Items covered included demographic data, reproductive history, physical activity, tobacco use, perceived health status (good, fair, poor), and sun exposure. Subjects were asked to list all medications, dietary supplements, and vitamin preparations currently being taken. They were also asked to list all chronic illnesses that they believed they had and also were specifically asked about certain common diseases.

Menopause was defined as cessation of menstrual periods for more than six months in a woman aged $\geq$45 years in the absence of known pregnancy. Women who met this definition were defined as postmenopausal and the remainder as premenopausal. Skin exposure to sunlight was determined from the subject's report of the average length of time in minutes per day she had spent in the courtyard of her house in the previous six weeks. In this cultural group, this is the place where the majority of sunlight exposure occurs because, in all other outdoor situations, women generally wear garments completely covering their body. Since sunlight exposure of over 15 minutes per day is considered the minimum necessary to produce adequate vitamin D (7), subjects were divided into those who met this requirement and those who did not.

Physical activity was estimated as the average over the last six weeks based on a series of questions validated for the assessment of customary activity in the elderly (8). These questions were chosen because female UAE citizens are rarely involved in sports activities. Five indicators of current activity were asked: time spent walking outdoors, walking speed, time spent standing indoors, frequency of muscle loading activity, such as climbing stairs or carrying a load, and time spent in productive or leisure activities, both indoors and outdoors. Four levels of intensity were defined for each indicator and were assigned a score of 1 to 4 with 1 being least active and 4 being most active. A composite score was derived from the above by summing the score for the five indicators. Missing values for physical activity were substituted with the median score for the subject's age group for each activity. The resulting score was subsequently divided into quartiles for analysis. The activities reported by women were also compared with the levels recommended by an expert panel as necessary to maintain health (9).

Anthropometric measurements

Standing height in centimetres and weight in kilograms were recorded for all subjects using an electronic weigh scale and a meter stick. Body mass index (BMI) was calculated from these two measurements. Using internationally-recognized definitions, underweight was defined as a BMI of <18.5 kg/m^2, overweight as BMI of 25-29.9 kg/m^2, and obesity as BMI of ≥ 30 kg/m^2 (10). Body fat content was measured in non-pregnant women by bioelectric impedance (Biodynamics Body Composition Analyzer, Model 310e, Biodynamics Corporation, Seattle, Washington, USA) following the manufacturer's instructions (11). This technique accurately estimates fat-free mass and total body water. From this and body weight, fat mass and percentage of body fat were estimated using the manufacturer's proprietary formulae. Obesity based on bioelectric impedance was defined as $\geq$35% of body fat as recommended in the User's Guide supplied by the manufacturer (11), although $\geq$40% of body fat was also examined as possibly more appropriate for women aged about 40 years (12).

Data processing and analysis

Data were processed using SPSS version 10.0 and Epi Info 2000. The results of analyses which were adjusted for the selection of more than one subject in the same family using the complex sample tables in Epi Info 2000 software did not differ from the results of analyses which ignored the sampling strategy. Therefore, the results of the simpler analyses are presented. Central tendency was expressed as mean and standard deviation (SD), and correlation was expressed as r. Chi-square test was used for ascertaining the significance of differences in proportions between two or more groups. Probability of <0.05 by 2-tailed test was considered to be statistically significant. For chronic diseases risk factors found to be highly prevalent, prevalence was adjusted for other associated exposure variables ($p<0.2$ on univariate analysis) by means of multiple logistic regression analysis.

RESULTS

In total, 183 households, which included 535 eligible women, were surveyed. Very few (5%) households approached refused to participate. No eligible woman in a participating household refused to participate in the survey, although a number of them refused or were unable to answer individual questions.

Table 1 shows the characteristics of the study subjects. Seventy-nine percent were citizens by birth rather than the marriage, thereby representing the indigenous population. Health status was generally good with only 25% reporting a chronic illness and 84% reporting sufficient exercise to meet expert recommendations. However, the majority was either overweight or obese (Table 2). Table 2 also shows that the majority of subjects was in the youngest age group, indicative of the age structure of this population. The mean age was 34.3 (SD 14.7) years. Age and education were highly significantly ($p<0.001$) associated in this rapidly developing population, with 84% of those aged over 40 years having no education and many of those aged less than 40 years (42%) having post-secondary education.

Obesity

The prevalence of overweight and obesity, as defined by BMI, in this population was 27% and 35% respectively (Table 2). Table 2 also indicates the major relationships between obesity, as defined by BMI, and other lifestyle and reproductive characteristics. BMI was chosen to define the various categories of weight in this table to allow for international comparisons. Body fat levels as measured by bioelectric impedance were similarly distributed in younger women. However, although prevalence of obesity as defined by BMI declined in women in the older age groups (Table 2.), in all age groups over 40 years had similar high prevalence rates of elevated body fat, whether 35% or 40% of fat was used as a cut-off. As expected, percentage of body fat was significantly correlated with BMI (r=0.67, p<0.001) but elevated body fat (whether 35% or 40% was used as a cut-off) identified a somewhat different group of the population as obese than did BMI of ≥30 (Table 3). Most women classified as obese by percentage of body fat but non-obese by BMI were aged over 40 years. Pregnant women had a weight distribution similar to non-pregnant women, and removing them from analysis of other factors made no difference in the findings.

Since obesity was so prevalent, univariate and multivariate logistic regression analyses were performed to identify other exposure variables significantly associated with it. Body fat percentage of ≥35 was chosen to define obesity for this analysis because it appeared to be the most accurate definition of obesity in these women (12). Univariate logistic regression identified the following variables as significantly associated (p<0.2) with obesity: education, age, physical activity score, health status (good/not good), presence of chronic illness, menopausal status, and number of pregnancies. Of these variables, education, menopausal status, and number of pregnancies were too highly correlated with age (coefficient >0.6 by Pearson or

Table 1. Characteristics of study subjects

Characteristics	Proportion (%) (95% confidence interval)	No. of subjects with valid responses
Citizenship		
UAE by birth	79 (75-82)	421
UAE by marriage	21 (18-25)	111
Menopausal status		
Postmenopausal	17 (14-20)	87
Premenopausal	84 (81-87)	439
Pregnancy status		
Pregnant	7 (5-10)	39
Not pregnant	93 (90-95)	489
Cigarette smoking		
Current smoker	2 (1-4)	8
Current non-smoker	98 (96-99)	485
Use of oral contraceptives		
Ever used	21 (20-27)	109
Never used	79 (75-82)	403
Perceived health status		
Good	73 (69-77)	385
Fair	22 (19-26)	118
Poor	5 (3-7)	26
Chronic illness		
Present	28 (24-32)	149
Absent	71 (67-75)	382
Percentage of body fat		
≥35	45 (40-50)	200
<35	55 (50-60)	247
≥40	21 (17-25)	94
<40	79 (75-83)	353
Sunlight exposure		
≥15 minutes/day	76 (72-79)	395
<15 minutes/day	24 (20-28)	122
Take vitamin supplements		
Yes	41 (37-45)	205
No	59 (55-63)	298
Take vitamin supplements (pregnant women)		
Yes	74 (58-85)	28
No	26 (15-42)	10
Physical activity		
Above minimal recommendations (9)	84 (81-87)	444
Below minimal recommendations (9)	16 (12-18)	85

Table 2. Proportions (expressed as %) of population and various subgroups of population within BMI-defined weight categories

Characteristics	Proportion underweight BMI <18.5	Proportion with ideal weight BMI 18.5-24.9	Proportion overweight BMI 25-29.9	Proportion obese BMI ≥30	No. (%) of subjects with valid responses
Total population (95% confidence interval)	8 (6-11)	31 (27-35)	27 (23-31)	35 (31-39)	521 (100)
Age (years)*					
20-29	12	41	26	21	266 (51)
30-39	3	15	33	49	88 (17)
40-49	3	14	23	60	73 (14)
50-59	2	26	28	44	43 (8)
60-69	4	30	30	37	27 (5)
70-79	4	38	33	25	24 (5)
Education*					
None	5	24	27	45	164 (32)
Primary	4	16	29	51	55 (11)
Secondary	12	29	23	36	145 (28)
Post-secondary	7	45	30	17	148 (29)
Physical activity score quartile*					
First	11	25	27	37	131 (25
Second	6	24	26	44	127 (25)
Third	9	35	24	31	128 (25)
Fourth	5	36	33	26	130 (25)
Menstrual periods					
Regular	7	32	28	34	315 (74)
Irregular	12	29	21	38	112 (26)
Menopausal status					
Postmenopausal	4	31	35	31	85 (17)
Premenopausal	8	31	26	35	427 (83)
Perceived health status*					
Good	5	31	29	34	373 (72)
Fair	10	29	22	38	116 (23)
Poor	27	27	27	19	25 (5)
Chronic illness present*					
Yes	6	22	26	47	144 (28)
No	8	34	28	30	373 (72)

* The association between BMI category and this characteristics is significant ($p<0.05$) by chi-square or Fisher's exact test if numbers were small
BMI=Body mass index

Table 3. Proportions (expressed as %) of subgroups of population defined by body fat content within BMI-defined weight categories

% body fat by bioelectric impedance	Proportion underweight BMI <18.5	Proportion with ideal weight BMI 18.5-24.9	Proportion overweight BMI 25-29.9	Proportion obese BMI ≥30	No. (%) of subjects with valid responses
<35	11	45	36	9	241 (55)
≥35	2	12	18	68	197 (45)
<40	8	35	32	25	344 (79)
≥40	2	10	13	75	94 (21)

BMI=Body mass index

Spearman correlation) to be entered in multivariate analysis with age. The remaining variables, such as age, physical activity score, health status, and presence of chronic illness, were entered into multivariate logistic regression analysis. Only age was a significant predictor of obesity in this analysis ($p=0.000$, odds ratio 1.05 with 95% CI 1.04-1.07, n=436). Use of BMI of ≥ 30 or body fat percentage of ≥ 40 as a definition of obesity led to similar results in multivariate logistic regression analysis.

Lifestyle

Those who were more physically active were significantly more likely to be better educated ($p<0.001$) and were also more likely to be younger ($p<0.001$) with all of those in the oldest age group falling into the lowest quartile for physical activity. Taking multivitamins was the most common in the 30-39-year age group (52%) and the least common in the 60-69-year age group (15%) ($p<0.01$). This activity was not significantly associated with level of education but was highly associated with pregnancy ($p<0.001$) with 74% of pregnant women taking multivitamins, whereas only 38% of non-pregnant women took multivitamins. Sunlight exposure of ≥ 15 minutes per day was significantly associated with both least (86% prevalence) and best educated (76% prevalence) groups and was also associated with reporting higher exercise levels ($p<0.01$ for both). There was no statistically significant association between sun exposure and age or menopausal status.

Reproductive health

The mean age, at menarche, of these women was 13.2 (SD 1.51) years with the median being 13 years and the range being 9 to 20 years. Of the non-pregnant, premenopausal women, 26% reported irregular menses and 23% reported current or past use of oral contraceptive pills. In women who had reached menopause, mean fertility was 5.2 children with a median of 7 children and a range of 0 to 12 child(ren). There was no significant association between the number of children and education because few postmenopausal women had received any education at all.

Pregnant women were similar to non-pregnant women. The only two areas of significant difference were a higher likelihood of taking multivitamins ($p<0.001$) and fewer reports of chronic illnesses ($p=0.001$) in pregnant women. They had a tendency to report better health but this did not reach statistical significance ($p=0.09$). No pregnant woman reported smoking. Postmenopausal women were significantly different from premenopausal women (Table 4). They were more likely to report poor health ($p<0.001$) and chronic illnesses ($p<0.001$), get less physical activity ($p<0.001$), have a higher percentage of body fat ($p<0.01$), and less likely to take multivitamins ($p<0.001$). It was not possible to record age at menopause in these women as most had poor recollection of the timing of their menopause.

DISCUSSION

The most important finding of this study is the high prevalence (35%) of obesity, as defined by BMI, among the subjects. Since the study population was a random sample of female UAE citizens residing in Al Ain city, this prevalence can be extrapolated at least to the female population of this city and possibly to the urban female population of UAE. This high prevalence of obesity represents a significant predictor of high rates of cardiovascular diseases, diabetes, osteoarthritis, and cancer in this population in the future and demands public-health action. Therefore, health services for these women should emphasize the prevention and treatment of obesity. Prevention programmes should begin in childhood since 21% of women are already obese by the third decade. Treatment programmes should be developed to appeal to women with limited education since the highest prevalence of this problem occurs among those with no education or primary education. Development of both prevention and treatment programmes would require further study of women's knowledge, attitudes, and practices in several areas, including physical activity, diet, and body image.

The prevalence of obesity among this population was higher than that reported for women in Europe (12), the USA (13), and developing countries (14), if age group-specific rates were considered, and the only groups reported to have comparable rates were U.S. black women (13), Kuwaiti women, and some Pacific Islanders (14). It was also higher than the 28% prevalence among females reported in a population-based survey of the same age groups in the same general area of UAE in 1989-1990 (3) but the rate (21%) in 20-29-year olds was lower than that reported in 1996 in a study of female students (30%) of UAE university (16). Unfortunately, the definition of obesity in the latter study was broader than that used in this study so direct comparisons are impossible. The prevalence of overweight and obesity among the 20-29-year old women was much higher (47%) than that reported in a survey of female UAE university student citizens aged 18-30 years in 1993 (28.4%) (15). An increasing prevalence of obesity over time has been reported in many other countries (12,13).

prevalence among the Al Ain women is reached in the 5th decade. The association between age and obesity was so strong that the risk of obesity (defined as $\geq$35% of fat), as determined by multivariate logistic regression, increased by 5% with every one year increase in age.

Table 4. Proportions (expressed as %) of premenopausal and postmenopausal women with various characteristics

Characteristics	Proportion of postmenopausal women with characteristics	Proportion of premenopausal women with characteristics	No. (%) of subjects with valid responses
Citizenship			
By birth	82	79	415 (79)
By marriage	18	21	108 (21)
Perceived health Status*			
Good	37	80	381 (73)
Fair	44	17	113 (22)
Poor	19	2	26 (5)
Chronic illness*			
Present	61	21	143 (27)
Absent	39	79	379 (73)
Percentage of body fat*			
<35	34	60	245 (56)
$\geq$35	66	40	194 (44)
<40	60	83	347 (79)
$\geq$40	40	17	92 (21)
Sunlight exposure (minutes/day)			
$\geq$15	81	75	388 (76)
<15	19	25	121 (24)
Vitamin supplements*			
Yes	21	44	202 (41)
No	79	56	293 (59)
Physical activity quartile*			
First	60	18	130 (25)
Second	17	26	130 (25)
Third	17	27	130 (25)
Fourth	6	29	130 (25)

* The association between menopausal status and this characteristics is significant ($p<0.05$) by chi-square or Fisher's exact test if numbers were small

The prevalence of obesity, as defined by BMI, declined among older and postmenopausal women, while the prevalence of high body fat content (defined as either $\geq$35% or $\geq$40%) did not decline. This supports other evidence that BMI tends to underestimate fatness as age increases, especially among women (12, 17,18). This may be because of the decline in muscle and bone mass with age. Since bioelectric impedance is felt to be a more accurate measure of body fatness than BMI, all women aged over 30 years in this population should be considered at high risk of obesity.

The change with age in prevalence of obesity, as defined by BMI, is similar to that observed among U.S. women (13). The peak prevalence among U.S. women, however, is reached in the 7th decade, while the peak

The associations between obesity and lower education and lower physical activity have been reported elsewhere (12).

Other than the high prevalence of obesity, the study subjects were generally healthy. They had a very low prevalence of smoking, and this does not appear to be changing over time as it is similar to the rate reported in the 1995 Family Health Survey (4). Most women reported good health and did not report significant chronic diseases, reported sufficient activity to meet levels recommended by an expert panel (9), and got sufficient sunlight exposure despite their customary dress. Most pregnant women were also in good health and took multivitamin supplements, possibly because these were prescribed free of charge to citizens at the primary healthcare centres. Most younger women were well-educated and physically active. Unfortunately, menopausal women did not share such good health and reported significant deficiencies in lifestyle and health status. Therefore, specific health-promotion programmes aimed at this group of women are recommended.

Since, in this population, age and education were highly correlated and also probably correlated with other unmeasured variables, such as socioeconomic status and cultural and social heritage in this rapidly developing society, it is not possible to elucidate the reasons for associations between risk factors, such as obesity and exposures, such as education and age. They are, however, real and useful for public-health planning of prevention and treatment programmes.

The mean age (13.2 years) at menarche in this population was significantly ($p<0.05$) higher than that reported in Britain (12.9 years) and the U.S.A. (12.9 years for whites and 12.1 years for blacks) (19,20). It was, however, significantly ($p<0.05$) younger than 13.8 years reported in a survey of all UAE women (both citizens and non-citizens) done in 1996-1997 (6). The rate of oral contraceptive use was lower than that reported in a recent UAE survey of married women (4). This is to be expected as many women in this survey were unmarried. Fertility of postmenopausal women was high (5.2) but lower than that reported in the UAE Family Health Survey for urban women aged over 40 years (4). This survey was conducted in 1995, and the fertility may have fallen in the intervening six years.

This study has several limitations. It was a cross-sectional survey and, as such, can only identify associations but cannot ascribe causality. In addition, many variables collected were self-reported by women and subject to reporting error. However, weight, height, and bioelectric impedance were measured, making the identification of obesity not subject to this weakness. The subjects were randomly selected from the citizen population of Al Ain city. Thus, findings can only be extrapolated to this population. Despite these limitations, the high prevalence of obesity is very likely to be a valid finding and warrants public-health action.

ACKNOWLEDGEMENTS

The study was conducted with the financial support of a United Arab Emirates University Year 2000 research grant and carried out in Al Ain, United Arab Emirates. We wish to acknowledge the contribution to the study by the female UAE citizens of Al Ain, without whose willing cooperation the study would not have been possible. We would also like to acknowledge the dedication of nurses who collected data.

REFERENCES

1. Preface. *In*: Halperin W, Baker EL. Public health surveillance. New York: Van Nostrand Reinhold, 1992:xv-xvi.
2. Bennett S, Woods T, Liyanage WM, Smith DL. A simplified general method for cluster-sample surveys of health in developing countries. *World Health Stat Q* 1991;44:98-106.
3. El Mugamer IT, Ali Zayat AS, Hossain MM, Pugh RNH. Diabetes, obesity and hypertension in urban and rural people of Bedouin origin in the United Arab Emirates. *J Trop Med Hyg* 1995;98:407-15.
4. Fikri M, Farid SM. United Arab Emirates family health survey 1995. Abu Dhabi: Ministry of Health, 2000.
5. United Arab Emirates. Ministry of Health. Reproductive patterns and child survival in the United Arab Emirates. Abu Dhabi: Ministry of Health, 1996.
6. Rizk DEE, Bener A, Ezimokhai M, Hassan MY, Micallef R. The age and symptomatology of natural menopause among United Arab Emirates women. *Maturitas* 1998;29:198-202.
7. Specker BL, Valanis B, Hertzberg V, Edwards N, Tsang RC. Sunshine exposure and serum 25-hydroxyvitamin D concentrations in exclusively breast-fed infants. *J Pediatr* 1985;107:372-6.
8. Dallosso HM, Morgan K, Bassey EJ, Ebrahim SB, Fantem PH, Arie THD. Levels of customary physical activity among the old and the very old living at home. *J Epidemiol Community Health* 1988;42:121-7.
9. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C *et al*. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *J Am Med Assoc* 1995;273:402-7.
10. NHLBI Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. Identification,

evaluation, and treatment of overweight and obesity in adults: the practical guide. Bethesda, MD: National Institutes of Health, 2000:10. (NIH publication no. 00-4084).

11. Biodynamics. Biodynamics model 310e body composition analyzer: users guide. 6th ed. Seattle: Biodynamics Corporation.
12. Seidel JC, Flegal KM. Assessing obesity: classification and epidemiology. *Br Med Bull* 1997;53:238-52.
13. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999-2000. *J Am Med Assoc* 2002;288:1723-7.
14. Martorell R, Khan LK, Hughes ML, Grummer-Strawn LM. Obesity in women from developing countries. *Eur J Clin Nutr* 2000;54:247-52.
15. Musaiger AO, Radwan HM. Social and dietary factors associated with obesity in university female students in United Arab Emirates. *J R Soc Health* 1995;115:96-9.
16. Amine EK, Samy M. Obesity among female university students in the United Arab Emirates. *J R Soc Health* 1996;116:91-6.
17. Gallagher D, Visser M, Sepúlveda D, Pierson RN, Harris T, Heymsfield SB. How useful is body mass index for comparison of body fatness across age, sex, and ethnic groups? *Am J Epidemiol* 1996;143:228-39.
18. Roubenoff R, Dallal GE, Wilson PWF. Predicting body fatness: the body mass index vs estimation by bioelectrical impedance. *Am J Public Health* 1995;85:726-8.
19. Whincup PH, Gilg JA, Odoki K, Taylor SJC, Cook DG. Age of menarche in contemporary British teenagers: survey of girls born between 1982 and 1986. *Br Med J* 2001;322:1095-6.
20. Herman-Giddens ME, Slora EJ, Wasserman RC, Bourdony CJ, Bhapkar MV, Koch GG *et al.* Secondary sexual characteristics and menses in young girls seen in office practice: a study from the pediatric research in office settings network. *Pediatrics* 1997;99:505-12.