

## و2000 الوزن في الأطفال والمراهقين السعوديين في الفترة ما بين عام 1994 السمنة وزيادة

بهاء أبا الخيل

**الخلاصة:** لقد تم استقصاء ظاهرة السمنة وزيادة الوزن عند الأطفال والمراهقين في جدة بالاعتماد على معطيات الفترة ما بين 1994 و2000. وقد تم اختيار الأفراد الذين تتراوح أعمارهم ما بين العاشرة والعشرين عاماً باستخدام عينات عشوائية متعدّدة المراحل والطبقات، وكذا مقاييس مباشرة لوزن الجسم والطول. وتم احتساب شرائح مئوية لمنسب كتلة الجسم وللوزن والطول لكل من طبقات العمر والجنس. ولوحظت زيادة منسب كتلة الجسم لدى الجنسين في الفترة ما بين 1994 و2000 في الشريحة المئوية الخمسين، مع زيادة أكثر في الشريحة المئوية الخامسة والثمانين والخامسة والتسعين. وقد لاحظنا زيادة وزن الجسم ومنسب كتلة الجسم في كل المجموعات العمرية، واحتل الذكور الذين تتراوح أعمارهم ما بين 10 و16 عاماً أعلى زيادة، بينما احتلت الإناث بين سن 14 و16 سنة أقل زيادة. ومن ثمّ، فلا بد من التدخلات الصحية العامة من أجل اتقاء السمنة وزيادة الوزن في الشباب أو التخفيف منهما

**ABSTRACT** Overweight and obesity trends were investigated for schoolchildren and adolescents in Jeddah using data from 1994 and 2000. Individuals aged 10–20 years were selected using multistage stratified random sampling and direct measurements were made of body weight and height. Percentiles were calculated for body mass index (BMI), body weight and height for specific age and sex strata. For both sexes, BMI increased between 1994 and 2000 at the 50th percentile but higher still at the 85th and 95th percentiles. The increase in body weight and BMI were marked for all age groups; however boys showed the largest increase aged 10–16 years, whereas girls showed the lowest at 14–16 years. Public health intervention is crucial to prevent or reduce overweight and obesity among youth.

### **Surcharge pondérale et obésité chez des enfants et des adolescents saoudiens entre 1994 et 2000**

**RESUME** Les tendances de la surcharge pondérale et de l'obésité ont été examinées chez des écoliers et des adolescents à Djedda en utilisant des données des années 1994 et 2000. On a recouru à un échantillonnage aléatoire stratifié pour sélectionner des sujets âgés de 10 - 20 ans, et des mesures directes du poids corporel et de la taille ont été effectuées. Les percentiles ont été calculés pour l'indice de Quételet, le poids corporel et la taille pour des strates d'âge et de sexe spécifiques. Pour les deux sexes, l'indice de Quételet a augmenté entre 1994 et 2000 au 50e percentile mais il a augmenté plus fortement encore aux 85e et 95e percentiles. L'augmentation du poids corporel et de l'indice de Quételet était marquée pour tous les groupes d'âge ; toutefois, les garçons montraient la plus forte augmentation à l'âge de 10 -16 ans tandis que les filles affichaient l'augmentation la moins importante à 14 -16 ans. Une intervention de santé publique est cruciale pour prévenir ou réduire la surcharge pondérale et l'obésité chez les jeunes.

### **Introduction**

Obesity is a public health problem worldwide with significant adverse health outcomes [1–4]. The prevalence of obesity has doubled over the last decades in several developing countries as well as in the USA and most Western countries [5]. Its increasing prevalence has compelled the WHO to include obesity on the list of the essential health problems in the world [4]. Obesity has been proposed as the most frequent cause of preventable deaths after smoking [6].

Development of obesity in childhood is associated with a simultaneous increase in the chronic diseases risk profile [7–12]. Excess weight in childhood is the leading cause of paediatric hypertension. Overweight children are at higher risk for developing long-term chronic conditions including adult onset diabetes mellitus, coronary heart diseases, orthopaedic disorders and respiratory diseases [8–14]. Many studies have demonstrated that overweight children tend to become overweight adults [15–18]. Also, overweight and obesity in childhood appears to increase subsequent morbidity whether or not obesity persists in adulthood [14–19].

Economic development in Saudi Arabia during the last 30 years has changed nutritional and lifestyle habits [20,21]. Even though these changes have influenced the quality and the quantity of food intake and predisposed people to a sedentary life, studies of overweight and obesity in Saudi Arabia, especially in young people, are far from adequate. Studies of change of prevalence of overweight and obesity over time are lacking. The combined prevalence of overweight and obesity in the country was estimated to be around 27.5% among boys (11.7% overweight and 15.8% obese) between 6 and 18 years of age in 1996 [22] and 28.0% among girls between 12 and 19 years in 1999 [23]. This widespread prevalence of overweight and obesity raises the question whether the trend is increasing or whether the existing health interventions are controlling the situation. This study investigated the change in overweight and obesity among schoolchildren and adolescents in Jeddah between the years 1994 and 2000.

## Methods

Jeddah is the second largest city in Saudi Arabia with a population of 2.2 million and 692 government schools and 327 private schools, of which approximately half are for boys and half are for girls.

Two datasets were used from surveys of students in the years 1994 and 2000. For both datasets, a multistage stratified random sampling technique with proportional allocation involving three major stages was used. In the first stage the required number of schools at each educational level in accordance with regional population distribution adjusted for social class was chosen. In the second stage, the required number of students from those schools was selected according to the total number of students in each region of the city. One class from each educational level in the selected schools was chosen at random to attain the required sample size; students from other classes were added to the sample where needed. All students in the selected class present during the study period were included. Only students of Saudi Arabian nationality were considered for this study [24]. Private school students were excluded from the year 2000 dataset since that category was not available for 1994.

Data were collected for both surveys by medical students trained in interview skills and directly supervised by the medical staff. Data were collected by in-person interviews using a structured questionnaire that included information on sociodemographic factors and direct measurements of body weight and height.

Weight was measured without shoes to the nearest 0.1 kg using a Seca personal scale (model 777, West Germany). Height was taken barefooted to the nearest 0.1 cm using a standard measuring tape. Body mass index (BMI) was calculated as the weight/height (kg/m<sup>2</sup>). Overweight was defined as BMI of  $\geq$  85th percentile to  $<$  95th percentile among age and sex specific strata, while obesity was defined as BMI of  $\geq$  95th percentile among age and sex specific strata [25–27].

Data entry and analysis were done using the SPSS, version 9. The 5th, 15th, 50th, 85th

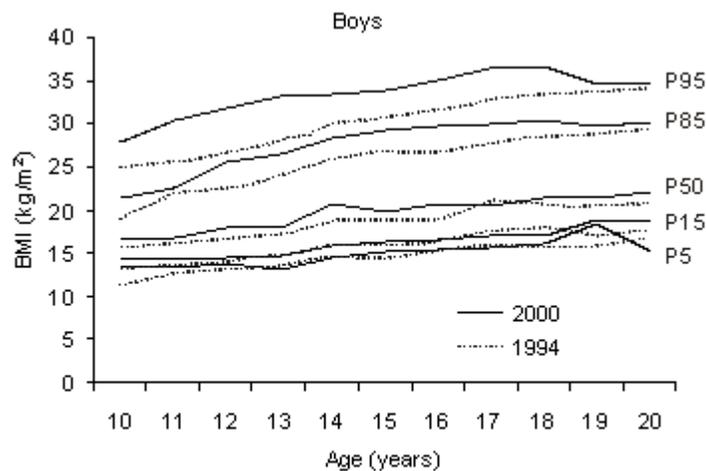
and 95th percentiles were calculated for each age and sex specific strata and compared between the years 1994 and 2000. Percentage differences in BMI at the 85th and 95th percentiles were calculated by subtracting the values for the year 1994 from the corresponding values in the year 2000 and dividing by the values for 1994.

## Results

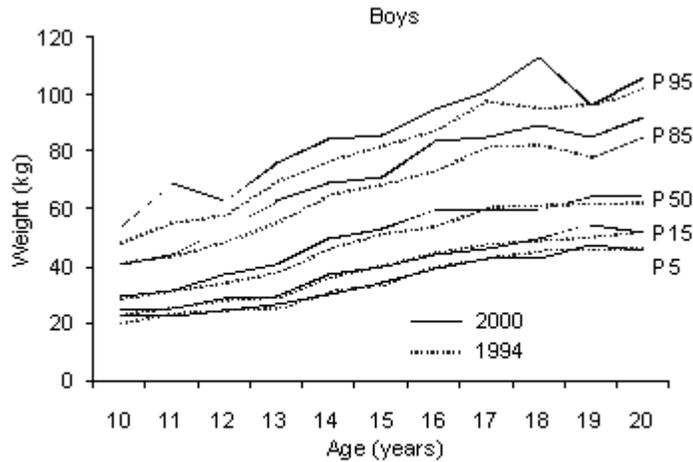
The study included 2708 Saudi students from the year 1994 survey and 2542 Saudi students from the year 2000 survey.

### Boys

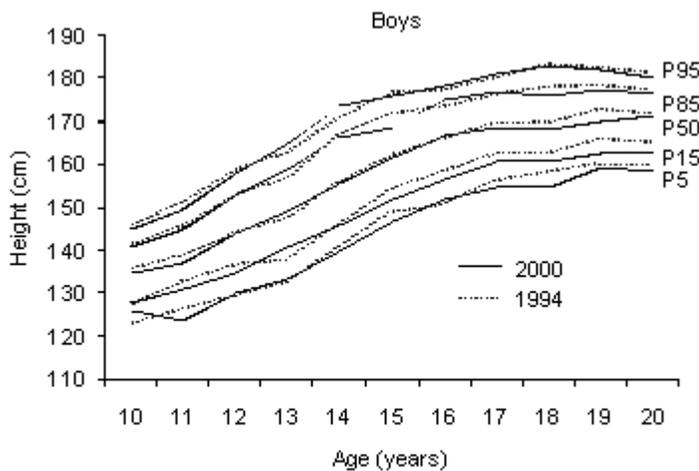
Data from the years 1994 and 2000 indicated an increase in BMI starting at the 50th percentile especially for boys between 12 and 16 years of age. A larger increase in BMI was observed at the 85th percentile and even greater at the 95th percentile. The increase in BMI at the 85th percentile was highest for boys up to 16 years of age, then declined gradually with age. The increase in BMI for boys at the 95th percentile followed nearly the same pattern (Figure 1). Similar increases in body weight at the 85th and 95th percentiles were observed (Figure 2). There was no visible difference in height between the years 1994 and 2000 for all percentiles among boys of all age groups (Figure 3).



**Figure 1 Body mass index (BMI) percentiles for 1994 (dotted line) and 2000 (solid line) for boys aged 10–20 years (P5 = 5th, P15 = 15th, P50 = 50th, P85 = 85th and P95 = 95th percentiles)**



**Figure 2 Weight percentiles for 1994 (dotted line) and 2000 (solid line) for boys for aged 10–20 years (P5 = 5th, P15 = 15th, P50 = 50th, P85 = 85th and P95 = 95th percentiles)**



**Figure 3 Height percentiles for 1994 (dotted line) and 2000 (solid line) for boys aged 10–20 years (P5 = 5th, P15 = 15th, P50 = 50th, P85 = 85th and P95 = 95th percentiles)**

## Girls

The increase in BMI among girls was observed starting at the 50th percentile. The highest increase was marked at the 85th percentile and became more obvious at the 95th percentile (Figure 4). The increase in BMI for girls at the 85th percentile was smallest up to the age of 15 years, then the difference in overweight between the years 1994 and 2000 increased gradually with age. The increase in BMI for girls at the 95th percentile was high up to the age of 13 years, declined from 14 to 16 years and then showed a sharp increase thereafter. Similar to boys, the increase in BMI at the 85th and 95th percentiles was mainly attributed to the increase in body weight (Figure 5) as there was no apparent difference in height between the years 1994 and 2000 for all percentiles among all age groups (Figure 6).

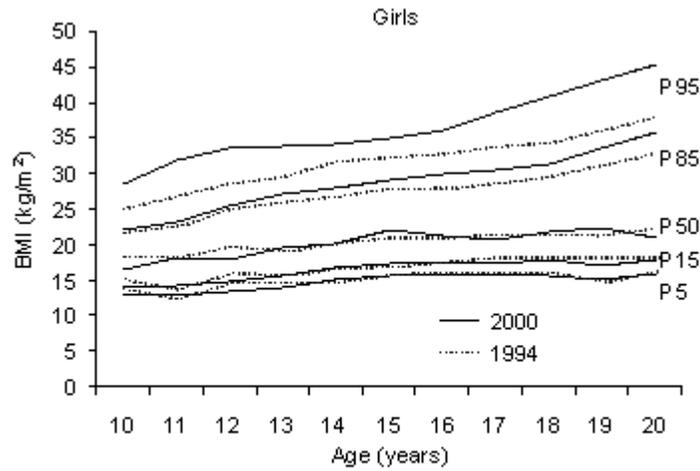


Figure 4 **Body mass index (BMI) percentiles for 1994 (dotted line) and 2000 (solid line) for girls aged 10–20 years (P5 = 5th, P15 = 15th, P50 = 50th, P85 = 85th and P95 = 95th percentiles)**

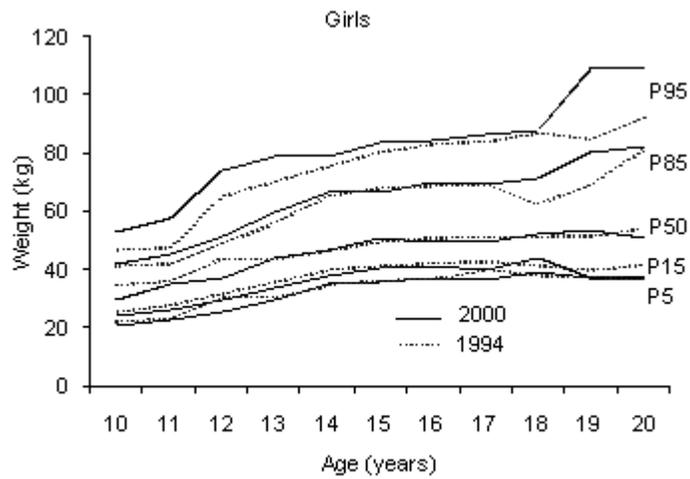


Figure 5 **Weight percentiles for 1994 (dotted line) and 2000 (solid line) for girls aged 10–20 years (P5 = 5th, P15 = 15th, P50 = 50th, P85 = 85th and P95 = 95th percentiles)**

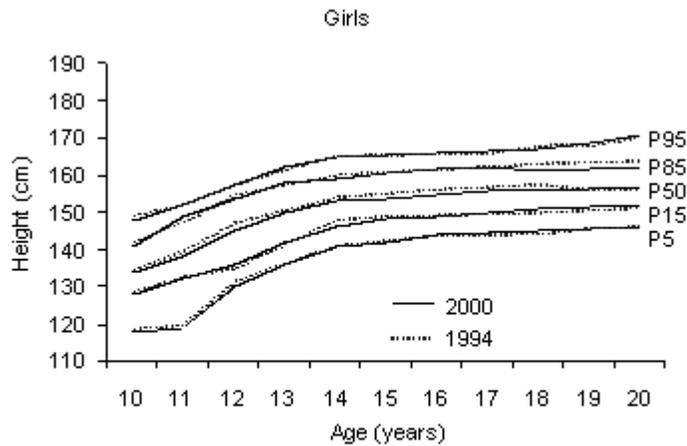


Figure 6 Height percentiles for 1994 (dotted line) and 2000 (solid line) for girls aged 10–20 years (P5 = 5th, P15 = 15th, P50 = 50th, P85 = 85th and P95 = 95th percentiles)

### Percentage difference in BMI at the 85th and 95th percentiles

Table 1 shows the percentage increase in BMI for the 85th and 95th percentiles by age and sex strata between 1994 and 2000. The increase in BMI between the years 1994 and 2000 for boys at the 85th percentile was highest up to the age of 16 years, ranging from 10% to 12%. This was followed by a gradual decline with age, reaching 2.9% at the age of 20 years. The increase in BMI for boys at the 95th percentile was higher than at the 85th percentile, with the largest differences between 11 and 13 years of age.

The increase in BMI for girls at the 85th percentile between the years 1994 and 2000 was smallest up to the age of 15 years and ranged from 2.4% to 4.9%. A gradual increase in BMI differences between the years 1994 and 2000 was observed with age, reaching 9.0% at the age of 20 years. The increase in BMI for girls at the 95th percentile was even higher than at the 85th percentile. Major differences were observed at the two age extremes ranging from approximately 14.0% to 19.0% for girls less than 14 years of age, followed by a decline to approximately 9.0% for the 14–16 age group and a gradual increase to 20.2% at the age of 20 years.

### Discussion

For both sexes, the increase in BMI in the year 2000 from the year 1994 was marked, starting from the 50th percentile. The degree of overweight and obesity defined by BMI at the 85th percentile and the 95th percentile increased considerably between the years 1994 and 2000. The increase for the 95th percentile was more marked than for the 85th percentile, which suggested that the prevalence of overweight was increasing and that the heaviest children were even heavier than before. In both sexes, the changes in overweight and obesity were mainly attributed to the increase in body weight rather than changes in height since there were no apparent changes in height over time.

This increase in body weight and in BMI was seen among boys, especially those aged 10–16 years. The increase in BMI among girls at the 85th percentile and the 95th percentile was apparent at all age groups but was lowest for those between 14 and 16 years of age. These results coincide with previously documented increases in

overweight and obesity in the United States and Western European countries [28–30].

One potential limitation of this study was the sampling variability between 1994 and 2000 survey data; the populations in both surveys, however, were from the same urban area (Jeddah) so sampling variability could not be the cause of increasing prevalence in overweight over time. Both datasets were restricted to only governmental schools. Private school data were excluded from the 2000 dataset, although there was no significant difference in overweight and obesity distribution between low and high socioeconomic status. This was done to eliminate any differences between the two datasets due to the socioeconomic distributions.

Methodological differences were another potential problem and might have accounted for the increase in overweight and obesity over time. This was unlikely, however, since the two datasets involved children attending the same grades in the same schools and used the same sampling methods, the same method of taking measurements and the same calibre of interviewers with the same training and preparation (fourth year medical students from the same university). Similarly, overweight and obesity were based on the same definitions in both surveys. Testing for linear trend was not possible because of the availability of only two datasets. Future surveys of obesity among children and adolescents in the same area will allow for testing for linear trend.

Our results agreed with previously published studies in the country. In a National Epidemiological Household Survey for Overweight and Obesity conducted among Saudi subjects of at least 20 years of age between 1990–93, obesity was found to have significantly increased in a trend from childhood to adolescence and through adult life and to older ages [32].

Lifestyle, genetic and environmental factors or a combination of these can predispose to obesity. A study of Saudi children in the eastern province of the country compared them to their American counterparts and found that they were not engaging in sporting activities [32,33]. Furthermore, many families in Saudi Arabia, especially in a big city like Jeddah, own at least one car and their children watch television, use computers and play electronic games for hours.

The prevalence of overweight and obesity was increasing among children and adolescents in Jeddah. This could pose an enormous future health problem, as the most overweight children were becoming more overweight. They are at increased risk of remaining overweight and obese in adulthood and consequently are at higher risk of subsequent health problems. The high levels of overweight and obesity could cause increased hospital service costs as well. Therefore, it is necessary to review the existing nutritional educational programmes for schoolchildren in Saudi Arabia. The school health curriculum could be restructured to accommodate nutritional programmes aimed at controlling overweight and obesity [33]. Childhood and adolescent overweight and obesity should be addressed from the public health perspective. The need for a public intervention is crucial to prevent or reduce overweight and obesity in the young. This intervention should be comprehensive, targeting children as well as parents with special emphasis on the importance of diet and healthy lifestyle. Such programmes should be evaluated to ensure their efficacy in reducing the prevalence of overweight and obesity in this population. Future surveys of overweight and obesity among children and adolescents in Jeddah should allow testing for linear trends.

### **References**

1. Kuczmarski RJ et al. Increasing prevalence of overweight among US adults.

*Journal of the American Medical Association*, 1994, 272:205–11.

2. Blair SN et al. Body weight change, all-cause mortality and cause-specific mortality in the Multiple Risk Factor Intervention Trial. *Annals of internal medicine*, 1993, 119:749–57.
3. Van Itallie TB. Health implications of overweight and obesity in the United States. *Annals of internal medicine*, 1985, 103: 983–8.
4. *Obesity; Preventing and managing the global epidemic. Report of a WHO Consultation on Obesity*. Geneva, World Health Organization, 1997 (Technical Report Series WHO/NUT/NCD/98.1).
5. Heitman BL. Ten-year trends in overweight and obesity among Danish men and women aged 30–60 years. *International journal of obesity*, 2000, 24:1347–52.
6. The American National Heart Lung and Blood Institute. The executive summary of the clinical guidelines on the identification, evaluation and treatment of overweight and obesity in adults. Review. *Archives of internal medicine*, 1998, 158:1844–67.
7. Dietz WHJ. Obesity in infants, children, and adolescents in the United States. I. Identification, natural history and aftereffects. *Nutrition research*, 1981, 1:117–37.
8. Aristimuno GG et al. Influence of persistent obesity in children on cardiovascular risk factors: the Bogalusa Heart Study. *Circulation*, 1984, 69:895–904.
9. Smoak CG et al. Relation of obesity to clustering of cardiovascular disease risk factors in children and young adults. The Bogalusa Heart Study. *American journal of epidemiology*, 1987, 125:364–72.
10. Lauer RM, Clarke WR. Childhood risk factors for high adult blood pressure: the Muscatine Study. *Pediatrics*, 1989, 84: 633–41.
11. Gidding SS et al. Effects of secular trends in obesity on coronary risk factors in children: the Bogalusa Heart Study. *Journal of pediatrics*, 1995, 127:868–74.
12. Gidding SS et al. Understanding obesity in youth. *Circulation*, 1996, 94:3383–7.
13. Guillaume M et al. Physical activity, obesity and cardiovascular risk factors in children. The Belgian Luxembourg Child Study II. *Obesity research*, 1997, 5:549–56.
14. Dietz WH. Childhood weight affects adult morbidity and mortality. *Journal of nutrition*, 1998, 128(suppl. 2):411S–4S.
15. Braddon F et al. Onset of obesity in a 36 year birth cohort study. *British*

*medical journal*, 1986, 293:299–303.

16. Serdula MK et al. Do obese children become obese adults? A review of the literature. *Preventative medicine*, 1993, 22:167–77.

17. Clarke WR, Lauer RM. Does childhood obesity track into adulthood? *Critical reviews in food science and nutrition*, 1993, 33:423–30.

18. Guo SS et al. The predictive value of childhood body mass index values for overweight at age 35. *The American journal of clinical nutrition*, 1994, 59:810–9.

19. Must A et al. Long-term morbidity and mortality of overweight adolescents. A follow-up of the Harvard Growth Study of 1922 to 1935. *New England journal of medicine*, 1992, 327:1350–5.

20. Musgrave KO, Achterberg CL, Thornbury M. Strategies for measuring adolescent snacking patterns. *Nutrition report international*, 1981, 24:557–73.

21. Al-Hazmi MA, Warsy AS. Relationship between obesity, overweight and plasma lipid in Saudis. *Saudi medical journal*, 1999, 20 (7):512–25.

22. Al-Nuaim AR, Bamgboye EA, al-Herbish A. The pattern of growth and obesity in Saudi Arabian male schoolchildren. *International journal of obesity and related metabolic disorders*, 1996, 20(11): 1000–5.

23. Abahussain NA et al. Nutritional status of adolescent girls in the eastern province of Saudi Arabia. *Nutrition and health*, 1999, 13(3):171–7.

24. Ghabrah T et al. The prevalence of cardiovascular risk factors among students in Jeddah, Saudi Arabia. *Journal of family and community medicine*, 1997, 4(2): 55–63.

25. Must A, Dallal GE, Dietz WH. Reference data for obesity: 85th percentiles of body mass index (wt/ht<sup>2</sup>) and tricep skin fold thickness. *American journal of clinical nutrition*, 1991, 53:839–46.

26. Dietz WH. Guidelines of overweight and adolescent preventive services: Recommendation from an expert committee. *American journal of clinical nutrition*, 1994, 59:307–16.

27. *Physical status; the use and interpretation of anthropometry. Report of a WHO Expert Committee*. Geneva, World Health Organization, 1995 (WHO Technical Report Series, No. 854).

28. Hulens M et al. Trends in BMI among Belgian children, adolescents and adults from 1969 to 1996. *International journal of obesity*, 2001, 25:395–9.

29. Troiano RP, Flegal KM. Overweight children and adolescents: description, epidemiology and demographics. *Pedia- trics*, 1998, 101:497–504.

30. Thomsen BL, Ekstrom CT, Sorensen TIA. Development of the obesity

- epidemic in Denmark: cohort, time and age effects among boys born 1930–1975. *International journal of obesity and related metabolic disorders*, 1999, 23:693–701.
31. Al-Nuaim A, al-Rubeaan K, Khoja T. *The Saudi National Epidemiological Study on Chronic Metabolic Diseases (Part II)*. Riyadh, Ministry of Health and King Saud University, 1997.
32. Dietz WH, Robinson TN. Assessment and treatment of childhood obesity. *Pediatrics in review*, 1993, 14(9):337–43.
33. Magbool G et al. Weight and height of Saudi children aged 6 to 16 years from the eastern province. *Annals of Saudi medicine*, 1993, 13(4):344–9.