Comparison of the growth standards between Saudi and American children aged 0-5 years

Yagob Y. Al-Mazrou, *PhD, FRCGP,* ***Maysoon M. Al-Amoud,*** *MBBS, MPHC,*
Sirrag E. El-Gizouli, *MBBS, MSc,* ***Tawfik Khoja,*** *DPHC, FRCGP,* ***Khalid Al-Turki,*** *MBBS, FFCM,*
Nasr E. Tantawi, *MPH,* ***Mohamed K. Khalil,*** *MPH, MD,* ***Khwaja M. Aziz,*** *MSc, PhD.*

ABSTRACT

Objective. To compare the national growth monitoring data with the National Centre for Health Statistics (NCHS) growth standards, which is currently used in the Kingdom of Saudi Arabia (KSA).

Methods: A cross sectional study following World Health Organization criteria in determining sample size was adopted, whereby 24,000 children from 5 regions were selected to be the desired sample. One hundred and two Primary Health Care centers were also selected randomly from the 5 regions, from where the sample was drawn. A special questionnaire was designed for the data collection. A pilot study was carried out to test the study instruments. Weight, height and head circumference were measured by standard procedures. This data was compared with the National Centre for Health Statistics (NCHS) data.

Results: The total number of children examined was 23,821, 11,913 boys and 11,908 girls, they were drawn from 102 health centers selected randomly. Comparing different percentiles for Saudi and NCHS data, there was a significant difference between the Saudi and American children.

Conclusion: In order to ensure a correct follow up for our children in KSA, the national figures are more appropriate to follow than the NCHS data.

Saudi Med J 2003; Vol. 24 (6): 598-602

The most commonly used reference populations for the analysis of group data and the determination of the growth pattern of individual children are the Stuart-Meredith populations, based on data collected on a relatively small number of children in Boston and Iowa during the 1930's and 1940's.[1] This reference had several shortcomings. This had led the Centre for Disease Control (CDC) to request the Committee on Nutritional Advisory of the National Academy of Sciences to undertake the task of identifying and recommending a more appropriate reference population for use in nutritional surveillance programs and in assessment of the nutritional status of population of children.[2] In 1974, CDC embarked upon the development of the recommended reference with the assistance of the Fels Research Institute and the National Centre for Health Statistics (NCHS). Data from Fels and the Pre-school Nutrition Survey (PNS) were used to produce percentiles of height for age, weight for height and weight for age for children up to age of 6 years.[3] In 1975, the final NCHS/CDC reference curves were developed utilizing the latest in mathematical and computer technology. Appropriate computer subroutines had been developed at the CDC and widely distributed

From the Preventive Medicine Department (Al-Mazrou, El-Gizouli), Field Epidemiology Training Program (Al-Amoud), Gulf States Council (Khoja), Primary Health Care Department (Aziz), Ministry of Health, Riyadh. Eastern Region Health Directorate (Al-Turki), Dammam, Tabuk Region Health Directorate (Tantawi), Tabuk, *Kingdom of Saudi Arabia.*

Received 23rd December 2002. Accepted for publication in final form 19th March 2003.

Address correspondence and reprint request to: Dr. Yagob Y. Al-Mazrou, Assistant Deputy Minister for Preventive Medicine, Ministry of Health, Riyadh 11176, *Kingdom of Saudi Arabia*. Fax. +966 (1) 4028941. E-mail: yalmazrou@hotmail.com

throughout the world.[2] Later, the World Health Organization (WHO) Committee suggested using the NCHS/CDC reference data in nutritional studies from both developed and developing countries and included a recommendation that SD scores be utilized to present population distribution in which a high percentage of values were outside the 5th and 95th percentiles.[2,4] The differences between the Stuart-Meredith and NCHS/CDC reference lie mainly in the extreme percentiles, while the medians are similar for height for age and weight for age. In addition, the NCHS/CDC reference curves are amenable to computer application.[2] The growth chart used to monitor the <5 years old children in health centers in the Kingdom of Saudi Arabia (KSA) were consists of weight for age, height for age and head circumference for age curves. Since there is no national standard for Saudi children's growth, the growth of Saudi children is measured by different standards. For example, the growth chart currently utilized in health centers was adopted in 1984 based on NCHS/WHO reference as a result of consultative meetings with WHO experts in Eastern Mediterranean Regional Office. We still have little knowledge on the growth status of Saudi children and the national standards for growth are not yet available. However, we are aware that their patterns of growth deviate from the reference standards established in Europe and United States of America (USA). Therefore, it is of utmost importance to develop national growth standards for Saudi preschool children, and to compare them with other reference standards currently used to detect any differences between them.

Methods. This is part of a national study involved 23,821 under 5 years old healthy Saudi children, 11,913 boys and 11,908 girls. The sample was drawn from the 5 regions of the community proportionate to the population density of the said regions. One hundred and two health centers were selected randomly from where the sample was drawn and 200 children were drawn from each month interval of 0-59 months old boys and girls. These children were measured for weight, height and head circumference by standardized precalibrated apparatuses. A cross sectional study with multistage random sampling was used and training of observers was carried out before the start of data collection. The data was processed using SPSS computer software. Selected percentiles of the Saudi 0-5 years growth standards were compared with the American Children Standards (NCHS) respective percentiles as a reference population.[5] This includes the Saudi and the NCHS 5th, 50th and 95th centiles. The percentiles were compared by graphing them in Excel software. Curves were drawn by the computer depending on the data of the NCHS centiles tables of weight for age, height for age and weight for height[6] with those of the local national centiles. In addition, the currently used growth curves for weight and height at the health centers were compared with this study results. Since they are based on Harvard standards, it is only possible to compare the median of weight and height for age for both boys and girls.

Results. The Saudi boys and girls with 5th, 50th and 95th percentiles of the height for age, weight for age and weight for height were compared with the respective US/NCHS growth standards by plotting the selected Saudi percentiles against the NCHS corresponding standards. For the weight for age for boys, the Saudi and NCHS had 5th, 50th, and 95th percentiles were not significantly different for the first 9 months but from 10 months on ward there was a significant difference ($p<0.05$) (**Figures 1 & 2**). As for length by age for boys no significant difference was detected between the 5th percentiles for the first 6 months, from 7 months onward the difference was significant ($p<0.05$) but the 50th and 95th percentiles did not have a significant difference until 23 months. In the stature by age comparison for boys the difference was significant ($p<0.05$) throughout the 24-59 months (**Figures 3 & 4**). Comparing weight by length between the 2 systems; the difference of the 5th percentiles was not significant until 63 cm but from 64-76 cm it became significant ($p<0.05$), the difference of the 50th percentiles was not significant until 72 cm, from 73 cm onward the difference was significant ($p<0.05$) and the difference of the 95th percentiles was not significant until 76 cm. All of the 5th, 50th and 95th percentiles differences were significant at 76 cm onward ($p<0.05$), for weight by stature for boys (**Figures 5 & 6**). The same was calculated for the difference between NCHS - Saudi girls percentiles, and the difference between NCHS and Saudi 5th percentiles for weight by age was not significant for the first 8 months but became significant ($p<0.05$) from 9 months and onward, the 50th and 95th percentiles difference was not significant for the first 10 months, thereafter, at 11 months onward it was significant ($p<0.05$) (**Figures 7 & 8**). As for length by age no significant difference was detected between the Saudi and NCHS 5th percentiles for the first 9 months, thereafter the difference was significant ($p<0.05$). The difference of the 50th percentile was not significant for the first 12 months, then at 13 months it was significant and continued to be significant throughout the second year. The Saudi with 95th percentiles were not significantly different from NCHS' for the first 6 months, thereafter it was significant. Comparing stature by age, the Saudi 5th, 50th and 95th percentiles for girls were significantly different ($p<0.05$) from NCHS at 24 months and throughout until 59 months. For weight by length, the Saudi 5th and 50th percentile difference from NCHS' became significant at 64 cm and onward. The difference of the Saudi 95th percentile became significant at 68 cm and onward ($p<0.05$) (**Figures 9 & 10**). As for weight by Stature for girls the Saudi 5th, 50th, and 95th percentiles had significant difference from NCHS' from 75 cm onward until 109 cm. (**Figures 11 & 12**).

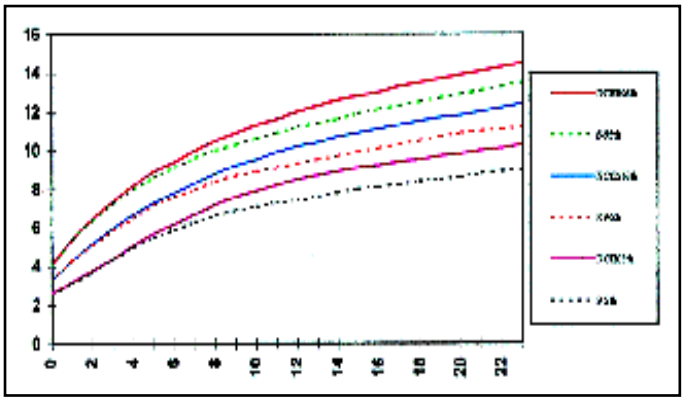

Figure 1 - Weight by age percentiles for National Center for Health Statistics - Saudi boys (0-23 months). Y axis - weight (kgs), X axis - age (months).

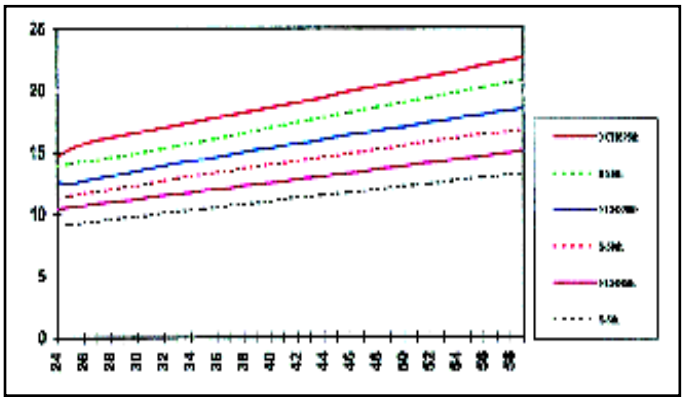

Figure 2 - Weight by age percentiles for National Center for Health Statistics - Saudi boys (24-59 months). Y axis - weight (kgs), X axis - age (months).

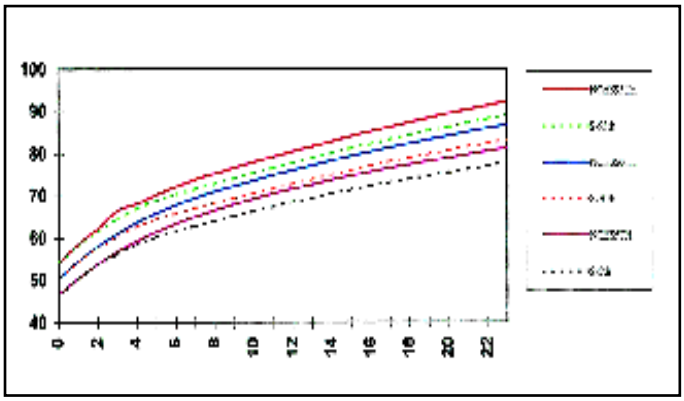

Figure 3 - Length by age percentiles for National Center for Health Statistics - Saudi boys (0-23 months). Y axis - length (cms), X axis - age (months).

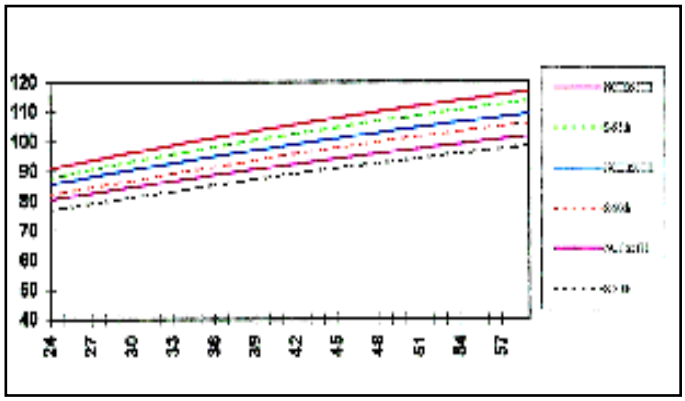

Figure 4 - Stature by age percentiles for National Center for Health Statistics - Saudi boys (24-59 months). Y axis - length (cms), X axis - age (months).

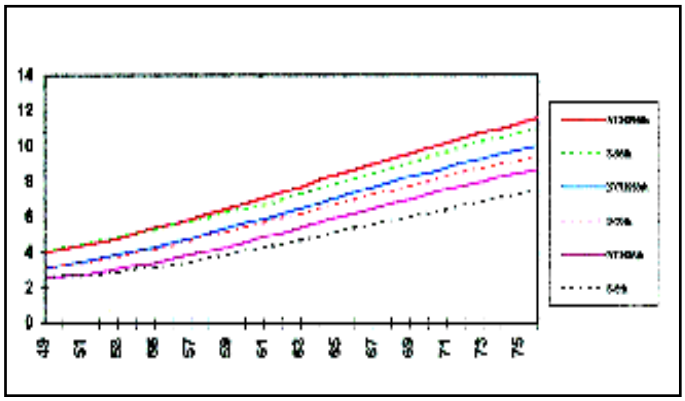

Figure 5 - Weight by length percentiles for National Center for Health Statistics - Saudi boys (49-76 cms). Y axis - weight (kgs), X axis - length (cms).

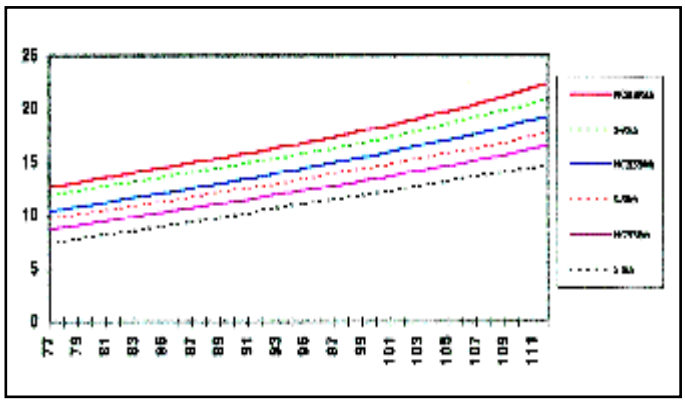

Figure 6 - Weight by stature percentiles for National Center for Health Statistics - Saudi boys (77-112 cms). Y axis - weight (kgs), X axis - stature (cms).

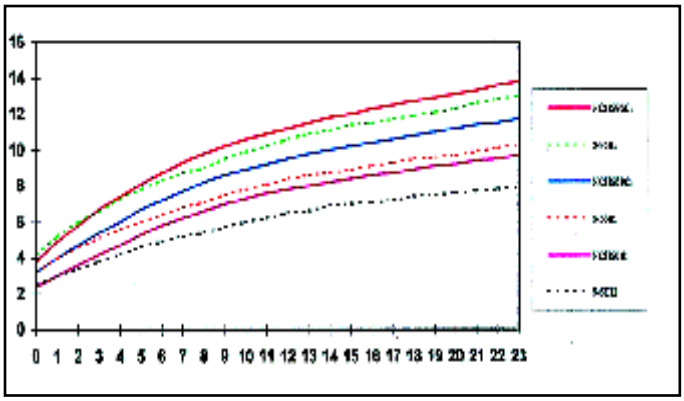

Figure 7 - Weight by age percentiles for National Center for Health Statistics - Saudi girls (0-23 months). Y axis - weight (kgs), X axis - age (months).

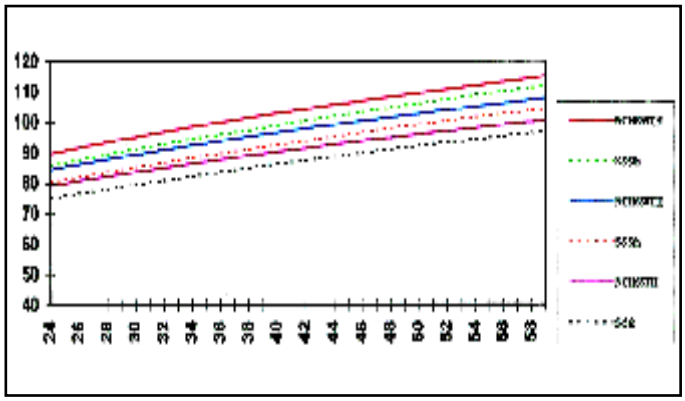

Figure 10 - Stature for age percentiles for National Center for Health Statistics - Saudi girls (24-59 months). Y axis - length (cms), X axis - age (months).

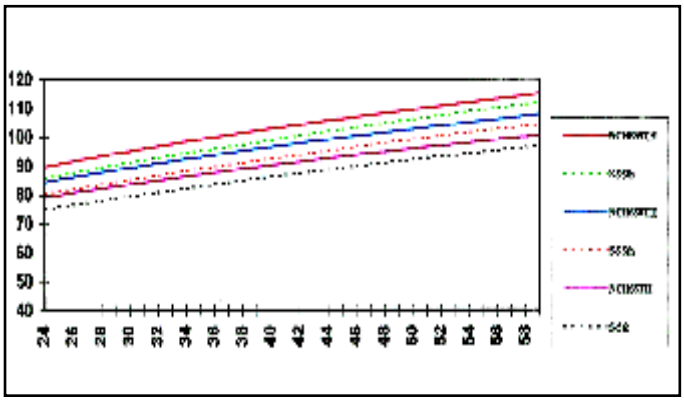

Figure 8 - Weight by age percentiles for National Center for Health Statistics - Saudi girls (24-59 months). Y axis - weight (kgs), X axis - age (months).

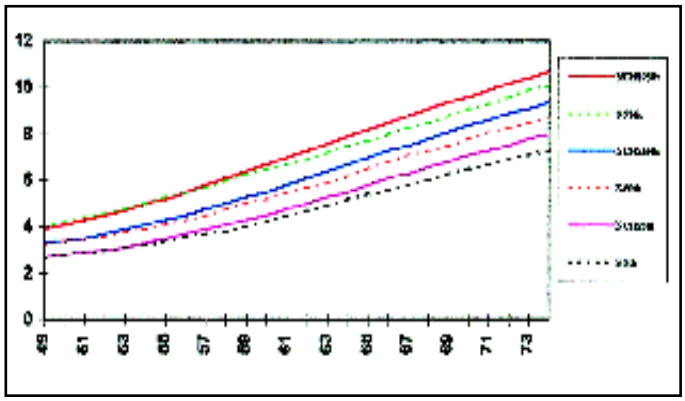

Figure 11 - Weight by length percentiles for National Center for Health Statistics - Saudi girls (49-74 cms). Y axis - weight (kgs), X axis - length (cms).

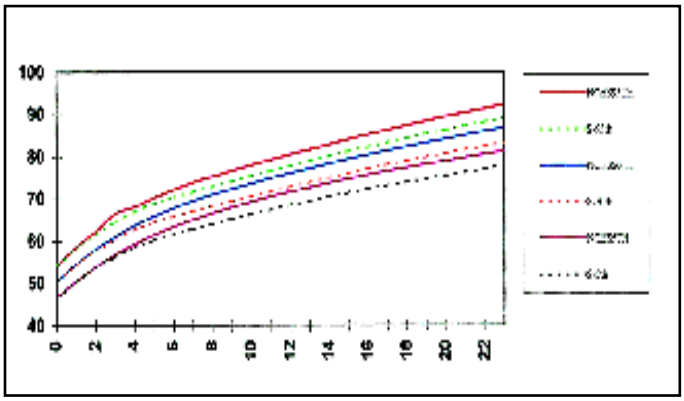

Figure 9 - Length by age percentiles for National Center for Health Statistics - Saudi girls (0-23 months). Y axis - length (cms), X axis - age (months).

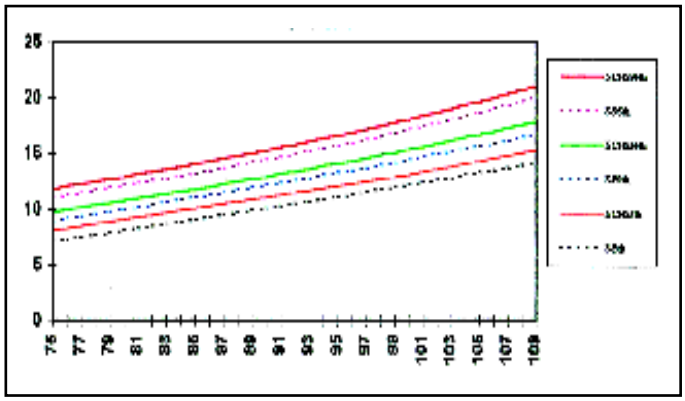

Figure 12 - Weight by stature percentiles for National Center for Health Statistics - Saudi girls (75-109 cms). Y axis - weight (kgs), X axis - stature (cms).

Discussion. Four studies of Saudi 0-5 years weight and height measurements for children had been conducted.[7-10] However, comparing their results with this study results was not possible, since either only growth charts were given without base line tables or the age grouping was every 3 or 5 months, unlike the present study, which was carried out for each single month. Therefore, it is not possible to determine the secular trend of Saudi children at this stage. The current 5th, 50th and 95th percentiles for Saudi 0-59 months growth standards comparison with their counterparts of NCHS percentiles revealed that at birth the Saudi children are very close to the NCHS reference standards in weight for age, height for age and weight for height. However, as the Saudi children grow older, they become shorter and thinner than the US children do. This difference starts to be significant as soon as the child is 5-6 months old. In addition, this study showed that the Saudi children below 5 years were shorter and lighter than the reference population. A similar finding was also noted by a local study in Riyadh[11] and another study that was reported from Jordan.[12] Therefore, the current study finding of the slower growth rate of the Saudis after the first few months and the findings of Riyadh school children study[13] lead to the fact that as the Saudi boys and girls grow older, they become shorter and thinner than the respective US children. This difference starts to be significant at the second half of the first year of life. This difference can be attributed to several factors, such as genetic, environmental and nutritional factors. These factors need to be investigated by in depth studies. The currently used growth curves for weight and height at the health centers were compared with this study results. Since they are based on Harvard standards, it is only possible to compare the median of weight, height for age for boys and girls.

In conclusion, there is a significant difference between the national growth monitoring data and the NCHS data, so it is important to use the national figures to avoid the drawbacks of NCHS standards, which are used for growth monitoring in KSA.

References

1. US Department of Health, Education and Welfare, Public Health Service, Centre for Disease Control. Evaluation of Body size and Physical growth of children. Atlanta (Georgia): US Department of Health, Education and Welfare, Public Health Service, Centre for Disease Control; 1977-1980.
2. Lane JM, Goldsby J, Nichaman M, Miller D. The use of National Center for Health Statistics/Centre for Disease Control reference data in evaluating the physical growth of children. Atlanta (Georgia): US Department of Health, Education and Welfare, Public Health Service, Centre for Disease Control; 1977-1980.
3. Gomez F, Romos-Galvan R, Frank S, Cravioto JM, Chavez R, Vasquiz J. Mortality in second and third degree malnutrition. ***J Trop Pediatr Afr Child Health*** 1956; 2: 77.
4. Waterlow JC, Buzina R, Keller W, Lane JM, Nichman MZ, Tanner JM et al. The Presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. Geneva: World Health Organization; 1977; 55: 489-498.
5. World Health Organization (WHO). Measuring change in nutritional status. Guidelines for assessing the nutritional impact of supplementary feeding programmes for vulnerable groups. Geneva: WHO; 1983.
6. World Federation of Public Health Associations. Growth Monitoring of Preschool Children: Practical Consideration Health for Primary Health Care Projects; Prepared for UNICEF. Geneva: World Federation of Public Health Associations; 1985.
7. Attallah NL. Patterns of growth of Saudi boys and girls from birth up to maturity in the Asir region: before the turn of the twentieth century. ***Saudi Med J*** 1994; 15: 414-423.
8. Al-Frayh AR, Jabbor FA, Al-Haque K, Al-Bawardy M, Adam KAR et al. Survey of auxological variance and growth standards in the Saudi newborn at various gestational ages and the preschool children in the Kingdom of Saudi Arabia. Riyadh (KSA): King Abdul-Aziz City for Science and Technology; 1989.
9. Al-Frayh AR, Wong S, Bener A. the growth standard of Saudi infants and preschool children in Riyadh, Saudi Arabia. ***Collegium Antropologium*** 1987; 11: 117-132.
10. Frayh A, Bangboye E, Moussa M. The standard physical growth chart for Saudi Arabian preschool children. ***Annals of Saudi Medicine*** 1993; 13: 155-159.
11. Attallah NL, Jibnel SO, Campbell JJ. Patterns of growth of Saudi boys and girls aged 0-24 months, Asir region, with a role on their rates of growth: a 1988 view. ***Saudi Med J*** 1990; 11: 466-472.
12. Salah M, Al-Qutob R, Rawashdeh M, Hijazi S. Growth patterns of Jordanian children: A national study. ***Journal of Family and Community Medicine*** 1995; 2: 47-53.
13. Al-Shoshan AA. The growth pattern of selected primary schoolchildren in Riyadh, Saudi Arabia. ***Saudi Med J*** 1983; 14: 53-58.