# Regional disparity in prevalence of malnutrition in Saudi children

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## ABSTRACT

**الأهداف:** تقييم اختلاف معدل انتشار سوء التغذية بين مناطق المملكة العربية السعودية.

**الطريقة:** جمعت هذه البيانات خلال عام 2004 و 2005م. أجريت دراسة مقطعية متعددة المراحل لحساب معدلات سوء التغذية في الأطفال تحت 5 عام. أجريت الدراسة في كلية الطب – جامعة الملك سعود – الرياض – المملكة العربية السعودية. أجريت القياسات البدنية للوزن والطول حسب المعايير النظامية، كما تم تحليل المعلومات بطريقة (LMS) المعروفة. تم حساب معدلات نقص الوزن والنحافة وقصر القامة بناءا على مرجع المركز الوطني الأمريكي للإحصاءات الصحية ومنظمة الصحة العالمية. كذلك تم اعتماد تعريفات منظمة الصحة العالمية إصدار 1978 لحساب معدلات نقص الوزن، النحافة، وقصر القامة كنسبة للأطفال تحت 2- انحراف معياري للوزن للعمر، الوزن للطول، والطول للعمر وذلك في ثلاث مناطق في الشمال، الجنوب، والوسطى. استخدم اختبار تشاي لتقدير اختلاف معدل انتشار سوء التغذية بين المناطق، واعتبرت القيمة الإحصائية أقل من 0.05 مهمة إحصائية.

**النتائج:** كان حجم العينة 5067 طفل في المنطقة الوسطى، و 2285 طفل في المنطقة الجنوبية الغربية، و 2933 طفل في المنطقة الشمالية تراوحت أعمارهم أقل من 5 عام. كان معدل انتشار نقص الوزن 4% في المنطقة الوسطى، و 19.7% في المنطقة الجنوبية الغربية، و 5.5% في المنطقة الشمالية. كذلك كان معدل انتشار النحافة 6.5% في المنطقة الوسطى، و 16.7% في المنطقة الجنوبية الغربية، و 6.5% في المنطقة الشمالية، بينما كان معدل قصر القامة 6.4% في المنطقة الوسطى، و 13.2% في المنطقة الجنوبية الغربية، و 6.4% في المنطقة الشمالية، مما يشير إلى معدل إحصائي مرتفع في المنطقة الجنوبية الغربية مقارنة بالمناطق الأخرى $p<0.001$.

**خاتمة:** تشير هذه النتائج إلى ارتفاع معدلات انتشار سوء التغذية لدى أطفال المنطقة الجنوبية الغربية مقارنة بالمناطق الأخرى مما يؤكد على ضرورة إجراء مزيدا من الأبحاث في المنطقة الجنوبية الغربية والمناطق الأخرى المشابهة لتقصي الأسباب ووضع البرامج المناسبة لتحسين الحالة الغذائية للأطفال.

**Objectives:** To evaluate the regional difference in the prevalence of malnutrition in Saudi children.

**Methods:** Data for this study were collected over 2 years (2004 and 2005). A cross-sectional representative sample of the Saudi population of healthy children below 5 years of age was used to calculate the prevalence of malnutrition. The study was carried out in the College of Medicine, King Saud University, Riyadh, Kingdom of Saudi Arabia. Body measurements of the weight, length, and height were performed according to standard recommendations. Standard deviation scores were determined using the Lambda, Mu, and Sigma (LMS) statistical methodology. The 1978 NCHS/WHO growth reference was used for the calculation of prevalence of underweight, wasting, and stunting defined as the proportion of children whose weight for age, weight for height, and height for age was below minus standard deviation (-2 SD) for Northern, Southwestern, and Central regions of the Kingdom of Saudi Arabia. Chi-square test was used to assess the difference in prevalence between regions, and a $p<0.05$ was considered significant.

**Results:** The sample size of children <5 years of age in Central region was 5067, Southwestern 2285, and Northern 2933. The prevalence of underweight was 4%, 19.7% and 5.5%, that of wasting was 6.5%, 16.7% and 6.5% and of stunting was 6.4%, 13.2% and 6.4% in the Central, Southwestern, and Northern regions indicating a significantly-higher prevalence in Southwestern compared to other regions ($p<0.001$).

**Conclusions:** This report revealed a high prevalence of significant nutritional indicators in the Southwestern regions than in other regions. This finding indicates that this region should be given priority for further studies to identify causes, and to design health promotion programs.

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Surveillance of prevalence of nutritional indicators in the form of weight for age (meaning underweight), height for age (meaning shortness or stunting), and weight for height (meaning wasting), is one of the important tools for monitoring child health. By definition, underweight and wasting suggest acute under nutrition whereas stunting is usually related to chronic malnutrition. Although national prevalence data are commonly used for this surveillance, variations not only between countries, but even within the same country may be important.[1-3] In the Kingdom of Saudi Arabia (KSA), the national prevalence of malnutrition in children below 5 years of age has recently been reported in comparison with data from other countries.[4] However, although qualitative regional variation in growth pattern has been reported from the KSA,[5] there are no data on regional variations in the prevalence of malnutrition. Therefore, the objective of this report is to evaluate the importance of regional difference in prevalence of malnutrition in Saudi children.

**Methods.** The study sample consists of children below 5 years of age in the national sample used for the national health profile project which was ethically approved and funded by King Abdul-Aziz City for Science and Technology in Riyadh.[6] Guidelines and criteria established by experts were followed for the design and methodology used in the national sample.[7] Accordingly, multistage probability sampling design was used to select a representative sample from a stratified listing of households based on the population census available at the time of the study. Data collection was made by house-to-house visits where a survey questionnaire, clinical examination, and body measurements were completed by primary care physicians and nurses. Measurements of the weight, recumbent length for children <2 years and standing height for those >2 years, were performed by physicians, and nurses members of the field teams according to the standard methodology.[7] Only healthy children were included in the analysis. The term healthy means healthy looking by history and physical examination. All children with apparent illness were excluded. Within this group, children whose weight for age, weight for height, and height for age will fall -2 SD of the reference were defined as underweight, wasted, and stunted. Further details of the design and methodology have been reported elsewhere.[8] For simplification purposes, the term height will be used instead of length/height throughout the article. The Lambda, Mu, and Sigma (LMS) statistical methodology was used to construct smoothed percentiles and standard deviation scores (z-scores).[9-11] The 1978 National Center for Health Statistics/World Health Organization (NCHS/WHO) growth reference and related software were used for the calculation of prevalence data.[12] The WHO cut offs were used for the definition of prevalence of underweight, wasting, and stunting as the proportion of children whose weight for age, weight for height, and height for age were -2 z-score. Prevalence data were calculated for 3 regions from the North (Hail, Jouf and Northern Borders), 2 from the Southwestern regions (Gizan and Asser), and 2 from the Central regions of the KSA (Riyadh and Qassim). Chi-square test was used to assess the difference in prevalence between regions and a $p<0.05$ is considered significant.

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**Results.** The total number of children below 5 years was 15,516 out of a total national sample of 35,279 with 50.5% boys and 49.5% girls. However, the study sample in this report is composed only of 10,285 children in the regions selected for regional comparisons (Central 5067, Southwestern 2285 and Northern 2933). The prevalence of underweight was 4% in the Central region, 19.7% in Southwestern and 5.5% in Northern indicating a significantly higher prevalence in Southwestern regions compared to the Central ($p<0.001$) and Northern regions ($p<0.001$) (**Table 1**. In addition, compared to the Central regions, there was a significantly higher prevalence of underweight in Northern regions ($p=0.002$).

**Table 2** shows a prevalence of wasting of 6.5%, 16.7% and 6.5% in the Central, Southwestern, and Northern regions with a clearly higher prevalence of wasting in Southwestern regions than in the Central ($p<0.001$) and the Northern regions ($p<0.001$), but no difference between Central and Northern regions.

Finally, **Table 3** depicts the prevalence of stunting of 6.4% in the Central, 13.2% Southwestern, and 6.4% Northern regions indicating significantly higher prevalence of stunting in Southwestern regions ($p<0.001$), but not between the Central and Northern regions. There was no consistent trends related to age or gender in any of the nutritional indicator.

**Discussion.** The prevalence of nutritional indicators in the form of underweight, wasting and stunting, is an important reflection of child health. National prevalence data are the most widely used to assess the level of nutrition. However, there are differences in growth and hence in nutritional status, not only between countries but also between regions of the same country more likely

due to environmental than to ethnic factors.[13,14] In this report, we compare the prevalence of malnutrition in Saudi children living in 3 groups of regions, which have different population characteristics. We used the older WHO/CDC reference in this study for the possibility of comparison with previous and new studies. Since this is a comparative study, the type of reference has little importance. The Central region (Riyadh and Qassim), representing most of multi-ethnic populations, 3 regions from the North (Hail, Jouf, and Northern Borders), most likely to have a stable Northern tribal population, and 2 regions from the Southwest (Asser and Gizan), also most likely to have most of stable Southwestern tribal population that is distinct from the North. The selection of these regions was made based on previous data indicating significant regional variation in the growth of Saudi children and adolescents.[5] The pattern of regional prevalence data in this report indicates that the prevalence of wasting and stunting is similar in the Central and Northern regions, except for underweight. However, the prevalence of all nutritional indicators (underweight [19.7%], wasting [16.7%] and stunting [13.2%]) is significantly higher in the Southwestern regions than in the Central and Northern regions. This high prevalence in the Southwest clearly contributes to the high national prevalence of underweight, wasting,

**Table 1 -** Prevalence of underweight by region.

| Age (years) | Central n (% ≤2 SD) | | | | | | Southwest n (% ≤2 SD) | | | | | | North n (% ≤2 SD) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | Girls | | Total | | Boys | | Girls | | All | | Boys | | Girls | | All | |
| <1 | 1693 | (1.7) | 1620 | (0.7) | **3313** | **(1.2)** | 604 | (4.3) | 573 | (4.3) | **1177** | **(4.3)** | 715 | (2.2) | 672 | (1) | **1387** | **(1.6)** |
| 1 - <2 | 398 | (5) | 381 | (2.6) | **779** | **(3.8)** | 152 | (19.7) | 142 | (16.9) | **294** | **(18.3)** | 254 | (5.9) | 208 | (3.4) | **462** | **(4.7)** |
| 2 - <3 | 120 | (0.8) | 119 | (5.0) | **239** | **(2.9)** | 82 | (24.4) | 100 | (25) | **182** | **(24.7)** | 124 | (4.0) | 126 | (4.8) | **250** | **(4.4)** |
| 3 - <4 | 124 | (4) | 126 | (4.8) | **250** | **(4.4)** | 91 | (25.3) | 106 | (22.6) | **197** | **(24.0)** | 125 | (4.0) | 154 | (7.8) | **279** | **(5.9)** |
| 4 - <5 | 122 | (5.8) | 107 | (7.5) | **229** | **(6.7)** | 107 | (27.1) | 102 | (22.5) | **209** | **(24.8)** | 139 | (5.8) | 140 | (6.4) | **279** | **(6.1)** |
| 5 - <6 | 146 | (6.2) | 111 | (3.6) | **257** | **(4.9)** | 109 | (21.1) | 117 | (23.1) | **226** | **(22.1)** | 152 | (13.2) | 124 | (6.5) | **276** | **(9.9)** |
| Overall | 2603 | (3.9) | 2464 | (4.0) | **5067** | **(4.0)** | 1145 | (20.3) | 1140 | (19.1) | **2285** | **(19.7)** | 1509 | (5.9) | 1424 | (5) | **2933** | **(5.5)** |

**Table 2 -** Prevalence of wasting by region.

| Age (years) | Central n (% ≤2 SD) | | | | | | Southwest n (% ≤2 SD) | | | | | | North n (% ≤2 SD) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | Girls | | Total | | Boys | | Girls | | Total | | Boys | | Girls | | Total | |
| < 1 | 1582 | (5.5) | 1502 | (4.6) | **3084** | **(5.1)** | 485 | (4.3) | 445 | (4.7) | **930** | **(4.5)** | 688 | (3.2) | 645 | (3.1) | **1333** | **(3.2)** |
| 1 - <2 | 398 | (6.3) | 381 | (4.2) | **779** | **(5.3)** | 152 | (22.4) | 142 | (12) | **294** | **(17.2)** | 254 | (5.9) | 208 | (3.8) | **462** | **(4.9)** |
| 2 - <3 | 120 | (9.2) | 119 | (5.0) | **239** | **(7.1)** | 82 | (26.8) | 100 | (25) | **182** | **(25.9)** | 124 | (6.5) | 126 | (3.2) | **250** | **(4.9)** |
| 3 - <4 | 124 | (4) | 126 | (6.3) | **250** | **(5.2)** | 91 | (19.8) | 106 | (12.3) | **197** | **(16.1)** | 125 | (8.8) | 154 | (7.8) | **279** | **(8.3)** |
| 4 - <5 | 122 | (9.8) | 107 | (6.5) | **229** | **(8.2)** | 107 | (18.7) | 102 | (12.7) | **209** | **(15.7)** | 139 | (7.2) | 139 | (7.2) | **278** | **(7.2)** |
| 5 - <6 | 146 | (7.5) | 111 | (8.1) | **257** | **(7.8)** | 109 | (20.2) | 117 | (21.4) | **226** | **(20.8)** | 152 | (9.9) | 124 | (11.3) | **276** | **(10.6)** |
| Overall | 2492 | (7.1) | 2346 | (5.8) | **4838** | **(6.5)** | 1026 | (18.7) | 1012 | (14.7) | **2038** | **(16.7)** | 1482 | (6.9) | 1396 | (6.1) | **2878** | **(6.5)** |

**Table 3 -** Prevalence of stunting by region.

| Age (years) | Central n (% ≤2 SD) | | | | | | Southwest n (% ≤2 SD) | | | | | | North n (% ≤2 SD) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | Girls | | Total | | Boys | | Girls | | Total | | Boys | | Girls | | Total | |
| < 1 | 1693 | (6.5) | 1619 | (3.2) | **3312** | **(4.9)** | 604 | (10.8) | 573 | (4.9) | **1177** | **(7.9)** | 714 | (5.2) | 672 | (4.5) | **1386** | **(4.9)** |
| 1 - <2 | 398 | (9.0) | 381 | (6.5) | **779** | **(7.8)** | 152 | (19.1) | 142 | (19.7) | **294** | **(19.4)** | 254 | (8.7) | 208 | (7.2) | **462** | **(8)** |
| 2 - <3 | 12 | (9.1) | 119 | (5.0) | **239** | **(7.1)** | 82 | (8.5) | 100 | (11.0) | **182** | **(9.8)** | 124 | (4) | 126 | (6.3) | **250** | **(5.2)** |
| 3 - <4 | 124 | (4.8) | 126 | (6.3) | **250** | **(5.6)** | 91 | (15.4) | 106 | (11.3) | **197** | **(13.4)** | 125 | (4.8) | 154 | (5.2) | **279** | **(5)** |
| 4 - <5 | 122 | (6.6) | 107 | (6.5) | **229** | **(6.6)** | 107 | (14.0) | 102 | (15.7) | **209** | **(14.9)** | 139 | (5.8) | 139 | (5) | **278** | **(5.4)** |
| 5 - <6 | 146 | (8.2) | 111 | (4.5) | **257** | **(6.4)** | 109 | (11) | 117 | (17.1) | **226** | **(14.1)** | 152 | (13.2) | 124 | (6.5) | **276** | **(9.9)** |
| Overall | 2603 | (7.4) | 2463 | (5.3) | **5066** | **(6.4)** | 1145 | (13.1) | 1140 | (13.3) | **2285** | **(13.2)** | 1508 | (7) | 1423 | ( 5.8 ) | **2931** | **(6.4)** |

and stunting that has been recently reported (6.9%, 9.8 and 10.9%) and considered in the middle between developed and developing countries, typical of many countries in transition.[4] Clearly, from a child health standpoint, national prevalence data alone may be misleading and regional data are needed to detect local variations, which might require further investigation. The potential causes of these variations are multiple. Although genetic factors are possible, environmental conditions that are known to affect child health in general and nutritional status particularly in the Southwest are clearly different from the other regions. For example, the altitude in Abha (Asser) is approximately 3000 meters above sea level compared to approximately 700 meters in the North and that of the Central region.[15] In addition, rural settlements account for approximately 56% in Asser and 68% in Gizan compared to approximately 23% in the North and Central regions.[6] Accordingly, higher altitude and predominance of rural settlements in the Southwest may explain some of these regional variations. Factors affecting prevalence of malnutrition are infant nutrition and parental education. Breast-fed children usually have better growth than those fed infant artificial formula either directly or indirectly by affecting the incidence and severity of infections leading to the recommendation of the WHO of exclusive breastfeeding for at least the first 6 months.[16,17] Another factor known to affect prevalence is the educational level of the head of the household. The higher education of the father, mother, or both the better health and therefore, lower prevalence of nutritional indicators in children.[18-20] This effect has been demonstrated in Saudi children indicating that the prevalence of all nutritional indicators doubles in children of illiterate fathers that of university level educated fathers.[21] Finally, other socioeconomic factors, access to adequate medical care and public health facilities may affect child health generally, and nutrition particularly.

The most important limitations of this report are the lack of data from other regions, separate analysis of prevalence in urban and rural settlements as well as unavailability of data allowing analysis of the contribution of various factors responsible for higher prevalence of nutritional indicators in the Southwestern region.

In conclusion, this report demonstrates the importance of regional prevalence data to identify important disparity. Documentation of high prevalence of all nutritional indicators in the Southwestern regions calls for further studies to identify the causes and to design appropriate health promotion programs to improve the nutritional status of children in these regions. In addition, reduction of prevalence of malnutrition in the Southwest and other regions of similar conditions will contribute to lower the national prevalence level of malnutrition.

## References


1. Use and interpretation of anthropometric indicators of nutritional status. WHO Working Group. ***Bull World Health Organ*** 1986; 64: 929-941.
2. WHO Multicenter Growth Reference Study Group. Assessment of differences in linear growth among populations in the WHO Multicenter Growth Reference Study. ***Acta Pediatrica*** 2006; Suppl 450: 56-65.
3. Shen T, Habicht JP, Chang Y. Effects of economic reforms on child growth in Urban and rural areas of China. ***N Engl J Med*** 1996; 335: 400-406.
4. El Mouzan MI, Foster PJ, Al Herbish AS, Al Salloum AA, Al Omar AA, Qurachi MM, et al. Prevalence of malnutrition in Saudi children: a community-based study. ***Ann Saudi Med*** 2010 (In press).
5. El Mouzan MI, Foster PJ, Al Herbish AS, Al Salloum AA, Al Omar AA, Qurachi MM, et al. Regional variations in growth of Saudi children and adolescents. ***Ann Saudi Med*** 2009; 29; 348-356.
6. El Mouzan MI, Al Salloum AA, Al Herbish AS, Qurachi MM, Al Omer AA. Health profile for Saudi children and adolescents. Final report of project No AR-20-63. Riyadh (KSA): King Abdulaziz City for Science and Technology; 2010.
7. Waterlow JC, Buzina R, Keller W, Lane JM, Nichaman MZ, Tanner JM. The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. ***Bull World Health Organ*** 1977; 55: 489-98.
8. El Mouzan MI, Al Herbish AS, Al Salloum AA, Al Omar AA, Qurachi MM. The growth charts for Saudi children and adolescents. ***Saudi Med J*** 2007; 28: 477-490.
9. Cole TJ, Green PJ. Smoothing reference percentile: The LMS method and penalized likelihood. ***Statistics in Medicine*** 1992; 11: 1305-1319.
10. Cole T J, Freeman JV, Preece MA. British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. ***Statistics in Medicine*** 1998; 17: 407-429.
11. Rigby RA, Stasinopoulos DM. Generalized additive models for location, scale and shape. ***Applied Statistics*** 2005; 64: 507-554.
12. NutStat, a nutrition anthropometry program that calculates percentiles and z-scores using either the 2000 CDC or the 1978 CDC/WHO growth reference. (Modified 2010 March 5, Accessed 2010 April 3). Available from URL: http://www.cdc.gov/epiinfo/
13. Habicht JP, Martorell R, Yarbrough C, Malina RM, Klein RE. Height and weight standards for preschool children. How relevant are ethnic differences in growth potentials? ***Lancet*** 1974; 1: 611-615.
14. Graitcer Pl, Gentry M. Measuring children: one reference for all. ***Lancet*** 1981; 2: 297-299.
15. Altitudes of Riyadh, Jouf, Arar, Gizan and Abha, Saudi Arabia. (Modified 2010 March 14, accessed 2010 April 3) Available from URL: http://en.wikipedia.org/wiki/Abha,weather.gladstonefamily.net/site/
16. Kramer MS, Guo T, Platt RW, Shapiro S, Collet JP, Chalmers B, et al. Breastfeeding and infant growth: biology or bias? ***Pediatrics*** 2002; 110: 343-347.

17. Kramer MS, Kakuma R. The optimal duration of exclusive breastfeeding. A systematic review. Geneva (SW): World Health Organization; 2002.
18. Gyrsoy A. Parental education and parental mortality. ***Health Transition Reviews*** 1994; 4: 183-223.
19. Duncan T, Strauss J, Henriques MH. How does mother's education affect child height? ***Journal of Human Resources*** 1991; 26: 183-211.
20. Desai S, Soumya A. Maternal education and child health: Is there a strong causal relationship? ***Demography*** 1998; 35: 71-81.
21. El Mouzan MI, Al Salloum AA, Al Herbish AS, Qurachi MM, Al Omer AA. Effect of education of the head of household on prevalence of malnutrition in Saudi children. ***Saudi Med J*** 2010; 31: 304-307.

**Related topics**

El-Mouzan MI, Al-Salloum AA, Al-Herbish AS, Qurachi MM, Al-Omar AA. Effects of education of the head of the household on the prevalence of malnutrition in children. ***Saudi Med J*** 2010; 31: 304-307.

Al-Hashem FH. The prevalence of malnutrition among high and low altitude preschool children of southwestern Saudi Arabia. ***Saudi Med J*** 2008; 29: 116-121.

Tayyem RF, Mrayyan MT. Malnutrition, and anthropometric and biochemical abnormalities in end-stage renal disease patients. ***Saudi Med J*** 2007; 28: 1575-1581.

Tayyem RF, Ahmad IM. Prevalence of malnutrition among end-stage renal disease patients in Jordanian Hospitals. ***Saudi Med J*** 2006; 27: 1928-1930.