CHAPTER 4:

ANTHROPOMETRIC STATUS

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Introduction

Physical growth is regulated primarily by two factors, namely genetics and the environment[1,2]. In terms of the latter, the quantity and quality of food available are major determinants of growth rate. In the health and related professions, anthropometry is generally used to determine the nutritional status of individuals and populations, and by implication the availability of adequate food. The relative ease with which the weight and height of an individual can be determined and compared with those of a well nourished individual of similar sex and age, lends the technique of anthropometry to being widely used in the assessment of the nutritional status of individuals and populations. The technique is also useful in the prediction of morbidity and mortality, the assessment of the effects of poverty as well as in the monitoring and evaluation of intervention programmes.

Macronutrient components of foods like protein, carbohydrate and fat, which are the sole contributors to energy intake, are the principal determinants of growth rate. For this reason, the anthropometric determination of nutritional status is indicative mainly of the availability of protein and energy foods.

UNICEF has estimated that approximately one out of three children younger than five years of age are chronically malnourished[1], and are thus trapped early in life in a pattern of ill health and poor development. In 1987, the United Nations sub-committee on nutrition and the World Health Organisation estimated that one-third to two-thirds of children in developing countries show some degree of growth retardation[2]. It is insufficiently appreciated that most of the excess infant mortality is due to hunger; even when the immediate cause of death is due to diarrhoea, pneumonia, measles or other infectious disease, death would have rarely occurred in a well nourished child.

Over the past two decades, a number of studies on preschool children have established the relatively high prevalence of protein-energy malnutrition (PEM) in preschool children [3-16] in the country. The percentages of under five year old children being underweight range from 21% in the Dias divisional council[6], 15% in Botshabelo[13] to 8% in rural South Africa[11].

Depending on its severity, the adverse effect of PEM on childhood mortality, impaired intellectual development as well as propensity to infections is well documented[17-26]. It is also widely accepted that PEM is associated with a number of micronutrient deficiencies of which vitamin A and iron are the most common. The restitution of these micronutrients to normal levels has the most dramatic effects on general health improvement[2]. In this regard, food fortification has been employed successfully in a number of countries in order to attain the amelioration of micronutrient deficiencies. In relation to food fortification and to the findings of a previous national survey[27] indicating that one out of four and one out of ten children under the age of six years were stunted and underweight respectively, the assessment of the anthropometric status of children aged 1 – 9 years was included in the present survey. The purpose of the inclusion was to compare the findings of the present national survey with the previous one in children under the age of six years and also to extend the currently available national data to the age of 9 years.

Methodology

Age and Gender Determination

The birth date and gender of the child were obtained from the birth certificate or the Road to Health Card. If none of these were available, then the birth date was obtained from the mother/caregiver. If the exact birth date could not be determined, then the birth year and/or birth month and or approximate birth date was obtained. If none of these could be obtained and the year of birth was also not known, then a replacement HH was selected for the survey. For the purpose of the present survey, the age of the child was defined according to completed years of life. A one year old child was 12 - 23.9 months of age; so a child of 14 months of age is older than one year and was included in the survey. At the other end of the spectrum only children younger than 108 completed months of age were included in the survey.

The head and arm circumference data were not analysed for the purpose of this report and hence they will not be presented herein.

Weight Determination

Using electronic scales, weight was determined in all the children. The average of two readings was used (Appendix: Instruction Manual). The following method was employed:

- The scale was placed on an even, uncarpeted area and was leveled with the aid of its in-built spirit level
- After the scale was switched on, the fieldworker had to wait for the zero indication (0,0) as well as the stable indicator (o in the top left hand corner of the display panel) to appear
- The children were weighed (preferably after emptying their bladders) and with the minimum of clothing. Diapers only for babies (dry only) or underclothes for older children were allowed
- The child was placed on the scale, standing still and upright in the middle of the platform, facing the fieldworker, looking straight ahead with their feet flat and slightly apart until the reading was taken
- After the reading was recorded in the space provided on the questionnaire, the child was removed from the scale. The weight was recorded to the nearest 100g
- After the child stepped down from the scale, the fieldworkers had to wait for the zero reading to appear on the digital display before repeating the procedure once
- The two readings could not vary by more than 100g. If they did, the scale had to be checked for accuracy and the procedure had to be repeated until the correct weight was obtained.

When the child/baby was not able to stand alone on the scale, the following method was employed:

- The first two steps above were followed
- The mother/caretaker was weighed first (without heavy clothing and shoes)

- Then the zero/reset button was pressed and the fieldworkers had to wait for the zero reading (0,0) to appear on the digital display
- The baby was then placed in the mother's arms and the reading taken and recorded
- The mother and child were then taken off the scale, and when the zero reading appeared again on the display the procedure was repeated once.

Height Determination

Children younger than 2 years

The supine length in these children was determined by means of a measuring board. Two readings were taken (average reported) and the measurement was repeated if the two readings varied by more than 0,5 cm: The following procedure was followed (Appendix: Instruction Manual):

- The measuring board was placed on an even, uncarpeted area
- Care was taken to ensure that the measuring board was functional and the foot-board had no undue loose movement
- The child was placed on the measuring board lying on his/her back with the crown of the head touching the fixed headboard and the shoulders touching the base of the board. One fieldworker was needed to hold the child in this position
- A second fieldworker ensured that the child's heels touched the board and the legs were straightened (knees not bent), before the foot-board was slid against the soles of the child's heels. The measurement was taken on the inside of the foot-board to the nearest 0,1 cm
- The measurement was recorded in the space provided on the questionnaire and the procedure was repeated once.

Children 2 years of age and older

The standing height of these children was taken by means of a stadiometer. Two readings were taken and the measurement was repeated if the two readings varied by more than 0,5 cm. The following procedure was followed (Appendix: Instruction Manual):

- The stadiometer was placed on an even, uncarpeted area
- The child's shoes were removed
- The child was positioned as follows:
  - facing the fieldworker
  - shoulders relaxed, with shoulder blades, buttocks and heels touching the measuring board
  - arms relaxed at sides
  - legs straight and knees together; and
  - feet flat, heels touching together
- With the child looking straight-ahead (Frankfurt plane), the headpiece was slid down until it touched the crown of the head
- The reading was taken to the nearest 0,1cm
- The measurement was recorded in the space provided on the questionnaire and repeated once.

Criteria Used for the Assessment of Anthropometric Status

The data were compared with those of the National Center of Health Statistics of the USA[28] using Epi Info version 6.02[29,30]. Ages were re-calculated as "biologic" ages, i.e. dividing the year into 12 equal segments. For each child, a z-score (i.e. the number of standard deviations (SDs) from the reference population median) was calculated for weight-for-height (W/H), weight-for-age (W/A) and height-for-age (H/A). If the z-score for weight-for-age or height-for-age was less than -6SDs or greater than +6SDs, or if the z-score for weight-for-height was less than -4SDs or greater than +6SDs, then the record was first verified for accuracy of data entry. Where an error had occurred on data entry, this was corrected; where no error could be detected, the indicator with such an extreme z-score was set to missing and, therefore, excluded from the analysis. The number of records with such extreme z-scores was 282 of which 10 were for H/A, 40 for W/H, 147 for H/A and W/H, 1 each for W/A as well as H/A and W/A, 16 for W/H and W/A and 67 for all three parameters. Furthermore, 1.5 and 4.5% of respondents returned a “don’t know” answer respectively for the type of dwelling and the level of maternal education. In relation to the anthropometric analysis, these responses were included in the total but were not further analysed.

Results

National

General

At the national level, stunting (H/A = < - 2 SDs) remains by far the most common nutritional disorder affecting nearly one out of five children (Figure 4.1; Table 4.1). On commercial farms, this disorder affects nearly one out of three children, whereas one out of four such children are similarly affected in the tribal or, collectively, rural areas. The children least affected (17%) were those living in urban areas. Even with regard to the latter, however, children living in informal urban areas were more severely affected (20%) as compared with those living in formal urban areas (16%). The prevalence of severe stunting (H/A = < - 3 SDs) was also higher in children living on commercial farms (12.5%) as well as in rural (8%) and in tribal (7%) areas as compared to the national average (6.5%), (Table 4.1).

A similar pattern emerged for the prevalence of underweight (W/A = < - 2 SDs), with one out of ten children being affected at the national level (Figure 4.1; Table 4.1). Nationally, less than 1.5% of children were severely underweight (W/A = < - 3SDs), except on commercial farms where the prevalence was 5% (Table 4.1).

Wasting (W/H = < - 2SDs) was by far less prevalent, affecting one out of twenty children living in rural and in tribal areas as well as on commercial farms, with severe wasting (W/H = < - 3SDs) being even less common (< 1%) at the national level (Figure 4.1; Table 4.1). By contrast, the prevalence of overweight (W/H = > + 2SDs) was higher (7.5%) in the urban areas (Figure 4.2; Table 4.1) than the national average (6%) and this was true for children living in the formal urban areas. The lowest prevalence of children being overweight was found on commercial farms (2.5%).

Figure 4.1 The anthropometric status of children 1 - 9 years of age nationally and by area of residence: South Africa 1999

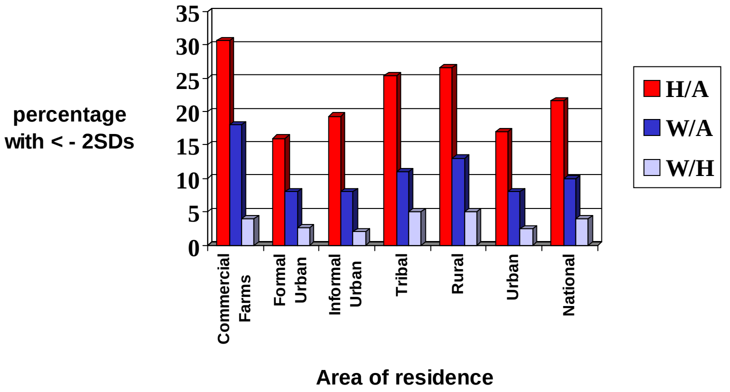
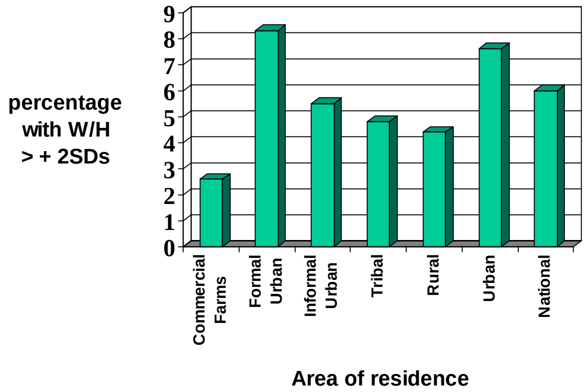


Figure 4.2 The anthropometric status of children 1 - 9 years of age nationally and by area of residence: South Africa 1999



Age groups

The prevalence of stunting decreased with age from 25.5% in children aged 1 – 3 years to 21% in those aged 4 – 6 years to 13% in those aged 7 – 9 years (Figure 4.3; Table 4.2). A similar, but less marked, pattern emerged for the prevalence of underweight, the prevalence for children aged 1 – 3, 4 – 6 and

7 – 9 years being 13% and 8% respectively. The prevalence of wasting remained constant in all age groups at less than 4% (Figure 4.3; Table 4.2), as did the prevalence of being overweight (6%), (Figure 4.4; Table 4.2).

Figure 4.3 The anthropometric status of children 1 - 9 years of age: South Africa 1999

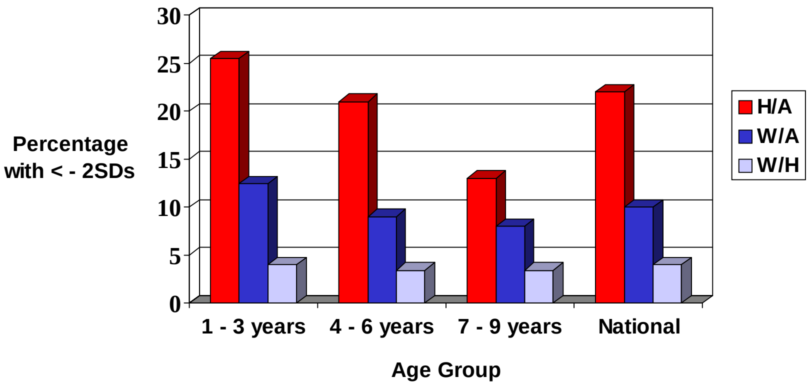
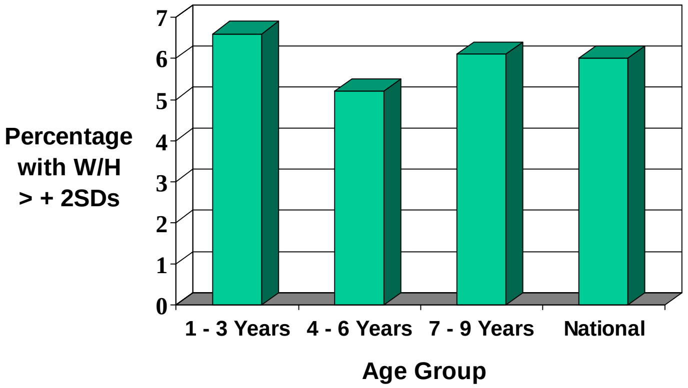


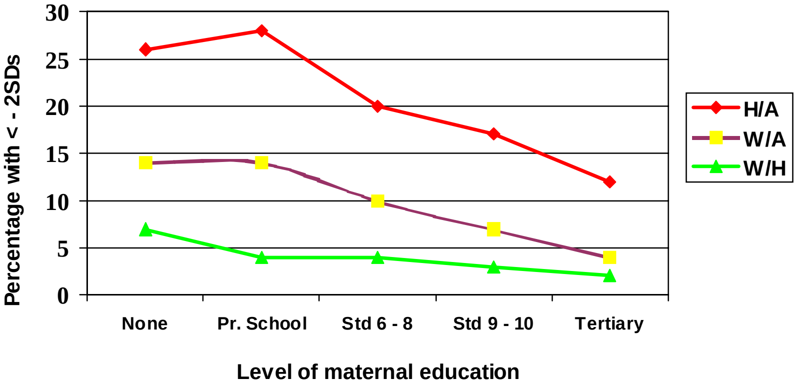
Figure 4.4 The anthropometric status of children 1 - 9 years of age: South Africa 1999



Level of maternal education

Improved maternal education was associated with a significant reduction in the prevalence of stunting, underweight and wasting (Figure 4.5) in all age groups of children (Table 4.3).

Figure 4.5 The anthropometric status of children 1 - 9 years of age by level of maternal education: South Africa 1999



This pattern was similar overall for the more severe forms of these nutritional disorders (Tables 4.3 – 4.4) as well as for children living in formal urban areas (Figure 4.6; Tables 4.5 – 4.6), but less markedly so for children living in informal urban areas (Table 4.7). However, the level of maternal education did not appear overall to have a significant, or consistent, influence on these anthropometric parameters (Tables 4.8 – 4.9; Figure 4.7), except for children living in tribal areas (Table 4.10). Nevertheless, a significant correlation (Spearman's) was found between the level of maternal education and stunting at the national level ($r = 0.17$; $p < 0.0001$) and for children living in urban areas ($r = 0.2$; $p < 0.0001$).

Figure 4.6 The anthropometric status of children 1 – 9 years of age by level of maternal education in urban areas: South Africa 1999

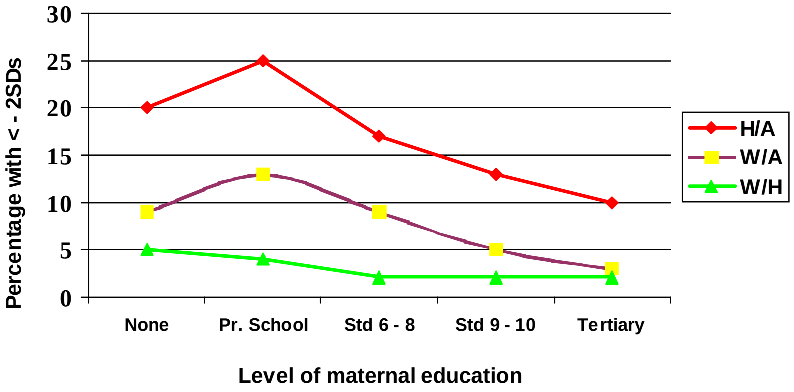
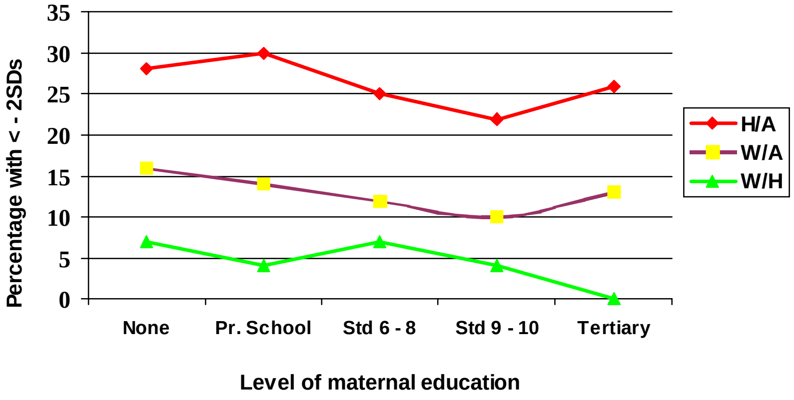


Figure 4.7 The anthropometric status of children 1 - 9 years of age by level of maternal education in rural areas: South Africa 1999



In addition, a correlation of the same magnitude and statistical significance was also found between the level of maternal education and underweight at the national level ($r = 0.11$; $p < 0.0001$) as well as with the area of residence (urban $r = 0.20$, $p < 0.0001$). Interestingly, improved maternal education was also associated with an increased prevalence of a child being overweight (Figure 4.8; Table 4.11), especially so for children living in formal urban areas (Figure 4.9; Table 4.12).

Figure 4.8 The anthropometric status of children 1 - 9 years of age by level of maternal education: South Africa 1999

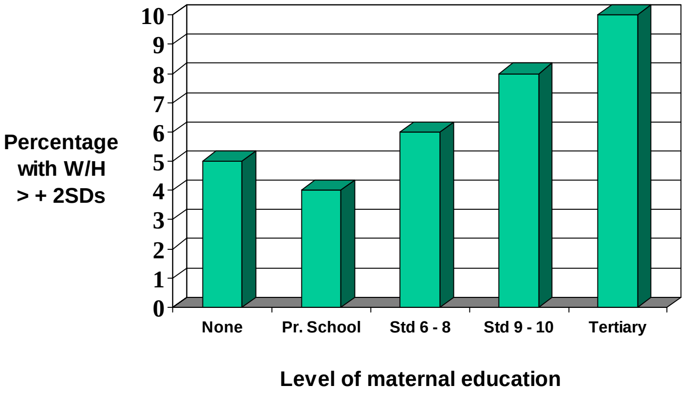
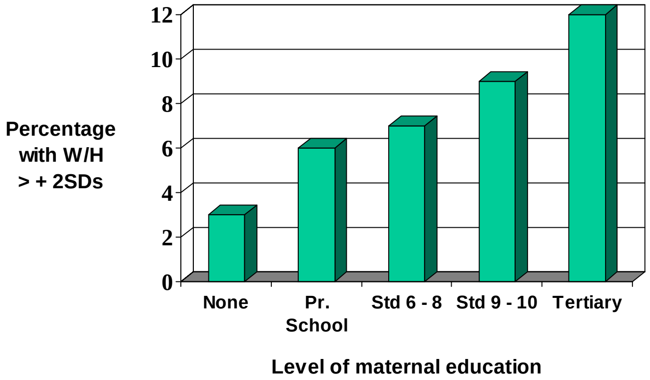


Figure 4.9 The anthropometric status of children 1 - 9 years of age by level of maternal education in urban areas: South Africa 1999



Type of dwelling

Children living in houses built with bricks or concrete had the lowest overall prevalence of stunting (Figure 4.10) in all age groups (Table 4.3 and 4.13). This, however, appeared to be the case only for those children living in urban (Figure 4.11; Tables 4.5 – 4.7) but not rural areas (Figure 4.12; Tables 4.8 – 4.11). The type of dwelling was related with stunting nationally (r = - 0.10; p <

0.0001) and for children living in urban areas (r = - 0.16; p < 0.0001), and for underweight children living in urban areas (r = -0.12; p < 0.001).

Figure 4.10 The anthropometric status of children 1 - 9 years of age by type of dwelling: South Africa 1999

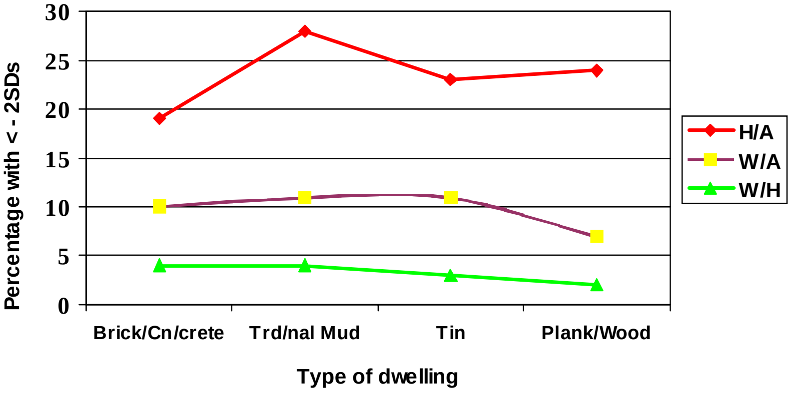


Figure 4.11 The anthropometric status of children 1 - 9 years of age by type of dwelling in urban areas: South Africa 1999

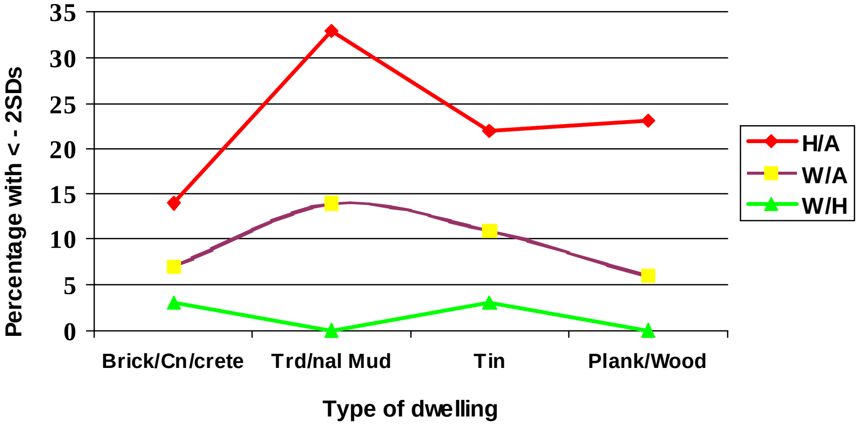
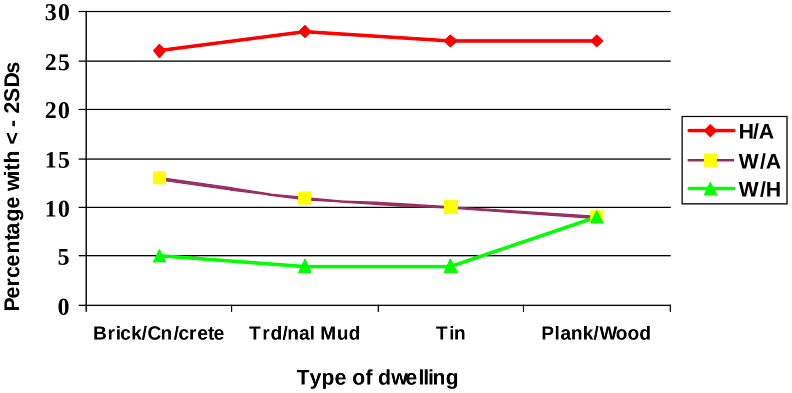


Figure 4.12 The anthropometric status of children 1 - 9 years of age by type of dwelling in rural areas: South Africa 1999

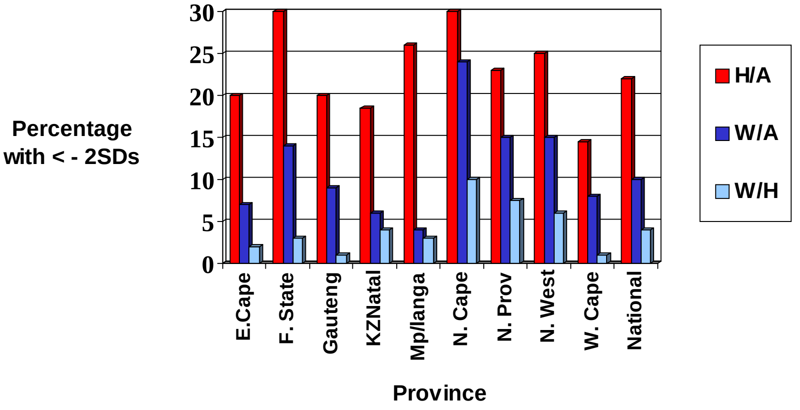


Provincial

General

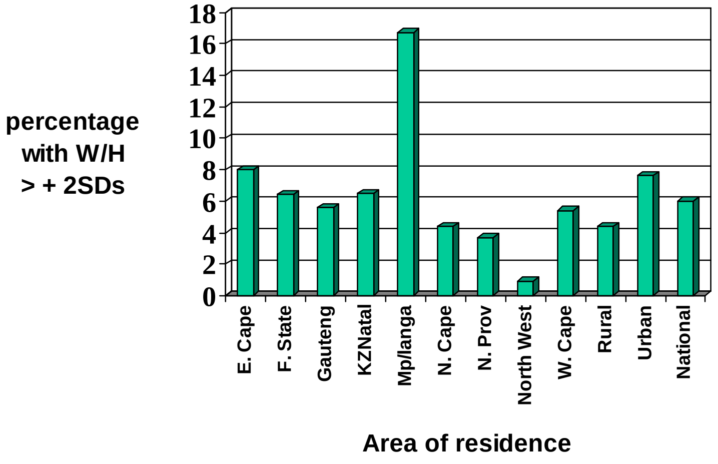
At the provincial level (Figure 4.13; Table 4.14), the prevalence of stunting was the highest in the Northern Cape (30%), the Free State (30%) and Mpumalanga (26%) followed by North West (25%), Northern Province (23%) and Eastern Cape (20%). The highest prevalence of underweight (Figure 4.13; Table 4.14) was in the Northern Cape (24%) followed by the Northern Province (15%), North West (15%) and the Free State (14%). The former two Provinces also had the highest (Figure 4.13; Table 4.14) prevalence of wasting [Northern Cape (10%) and the Northern Province (7.5%)]. The prevalence of severe stunting was the highest in the Northern Cape (14%) followed by the Free State (10%) and Mpumalanga (10%), whereas the highest prevalence of both being severely underweight and being wasted was found in the Northern Cape (9% and 2% respectively) (Table 4.14). Children in the Northern Cape, therefore, consistently had the poorest nutritional status.

Figure 4.13 The anthropometric status of children aged 1 - 9 years by province: South Africa 1999



In terms of overweight (Figure 4.14; Table 4.14), the highest prevalence was recorded in Mpumalanga (17%) with only the Eastern Cape (8%), Free State (6.2%) and KwaZulu/Natal (6.5%) as well as children living in urban areas (7.7%) exceeding the national average (6%).

Figure 4.14 The anthropometric status of children 1 - 9 years of age nationally and by area of residence: South Africa 1999



Age groups

The prevalence of stunting was the highest in all Provinces in children in the 1 – 3 years age group (Figure 4.15; Tables 4.15 - 4.17). The overall pattern was for the prevalence of stunting to decrease with age (Figure 4.15) in all Provinces except in Mpumalanga, Northern Cape, Northern Province and the Western Cape. Nevertheless, the smaller number of children in the older age groups should be borne in mind in interpreting this data. A similar pattern was observed for the prevalence of being underweight (Figure 4.16; Tables 4.15 - 4.17). However, there was neither such overall tendency for wasting, nor for severe stunting or being underweight or wasted, nor for being overweight (Tables 4.15 – 4.17). The percentage of children with stunting, underweight and with wasting was consistently higher in all age groups in rural as compared with those living in urban areas (Tables 4.18 – 4.20). The reverse pattern was, however, the case for children being overweight (Tables 4.18 – 4.20).

Figure 4.15 The prevalence of stunting of children aged 1 - 9 years by province and age group: South Africa 1999

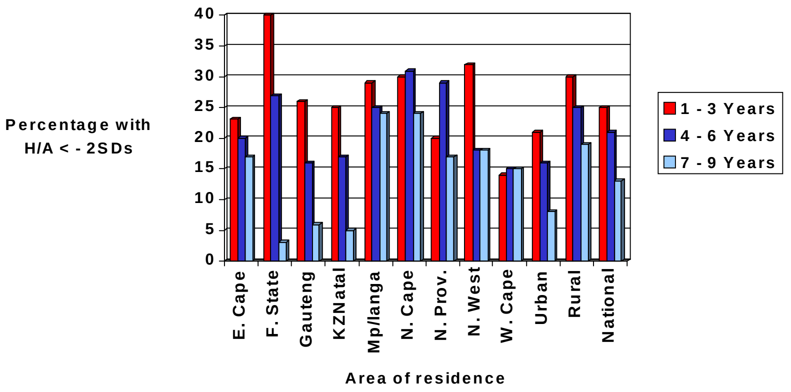
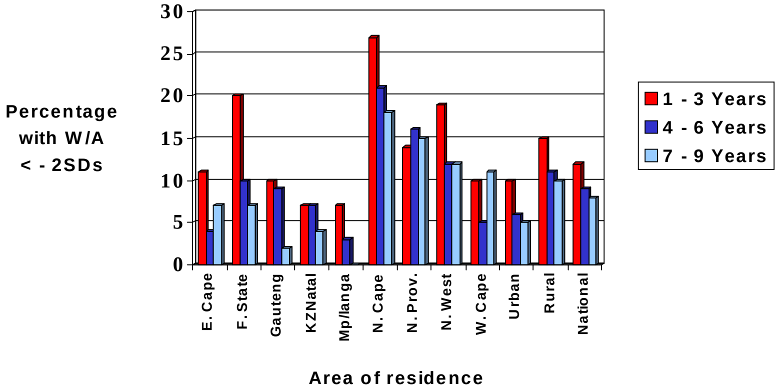


Figure 4.16 The prevalence of being underweight of children aged 1 - 9 years by province and age group: South Africa 1999



Level of maternal education

Higher level of maternal education was associated with a lower prevalence of stunting in almost all Provinces (Tables 4.21 – 4.29). Indeed, a significant correlation was found between the level of maternal education and stunting as well as underweight in six of the nine Provinces, and for wasting in three of the nine Provinces ($p < 0.05$). A tendency was also found in 4 of the 9 Provinces for children to be overweight with higher levels of maternal education (Table 4.30).

Type of dwelling

Children living in houses made of brick or concrete had overall the lowest prevalence of stunting with the exception of children in Mpumalanga and the Northern Cape (Tables 4.21 – 4.29). However, there was no overall pattern of a significant correlation between the type of dwelling and the prevalence of stunting, being underweight or wasted in the majority of the Provinces. Interestingly, there was a higher prevalence of being overweight in children living in formal housing (Table 4.30).

Comparison with the 1995 SAVACG[27] Survey

Despite the well-recognised and inherent limitations of such comparisons, the data from the present survey also were analysed by grouping together all children 12 – 71 months of age. The purpose of such an analysis was to compare the data of the present survey with that of the children in a similar age range in the SAVACG survey. In terms of stunting, the national average prevalence has not changed remarkably, whereas a slight increase in prevalence was noted in children living in urban areas (Figure 4.17). The prevalence of stunting seemed to have decreased in the Eastern Cape and the Northern Province, whereas the prevalence appeared to have almost doubled in Gauteng, and increased noticeably in KwaZulu/Natal, Mpumalanga and the Northern Cape. The prevalence of underweight (Figure 4.18) appeared to have increased in children living in the rural areas, remarkably so in the Northern Cape, and decreased in the Eastern Cape. The prevalence of wasting appeared to have decreased in the Eastern Cape and the Free State. However, an increase in the prevalence of wasting (Figure 4.19) was noted at the national level, in children living in rural areas as well as in KwaZulu/Natal, North West, and, most remarkably, in the Northern Province and Northern Cape.

Figure 4.17 Comparison of the prevalence of stunting in children aged 12 - 71 months from the present survey with that of children of the same age as obtained from the SAVACG survey (1995)

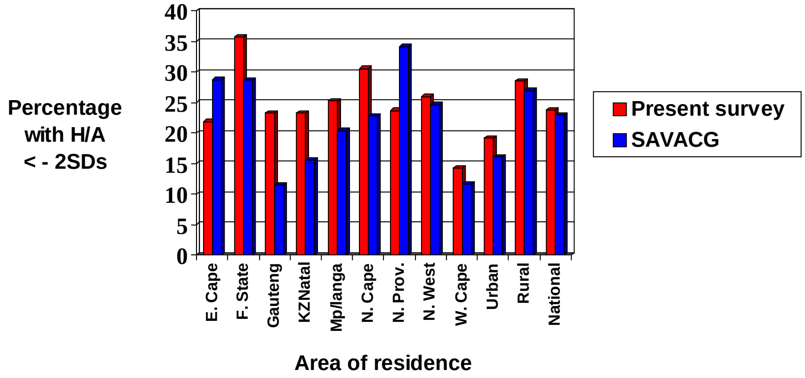


Figure 4.18 **Comparison of the prevalence of underweight in children aged 12 - 71 months from the present survey with that of children of the same age as obtained from the SAVACG survey (1995)**

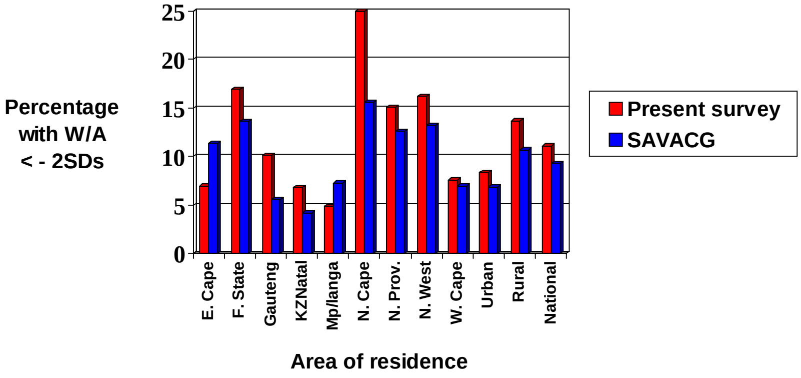
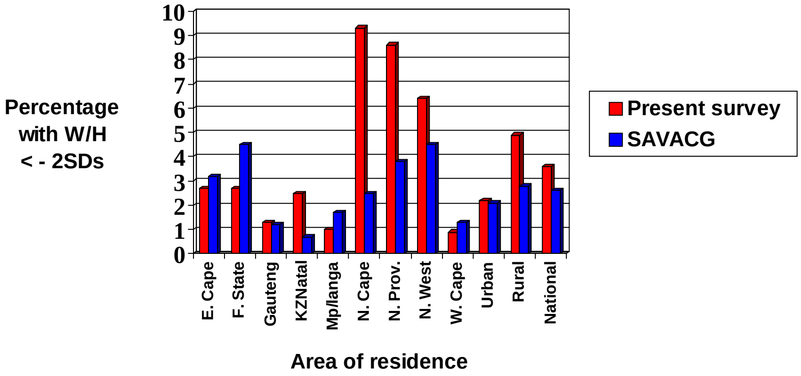


Figure 4.19 **Comparison of the prevalence of wasting in children aged 12 - 71 months from the present survey with that of children of the same age as obtained from the SAVACG survey (1995)**



For a “closer” comparison in terms of age, the data of the present survey was also analysed per year for the first 5 years of the present survey’s age range (Table 4.31- 4.32). Although, overall, there appears to be a small upwards tendency in most age groups, it can be stated with a reasonable degree of certainty that at the national level the nutritional status of children aged 12 – 71 months has not deteriorated since 1995. In this regard, it should be borne in mind that the present survey placed particular emphasis on the high risk segments of the population and as such it has captured a greater percentage of households of lower socio-economic status than the SAVACG survey.

Discussion

In the present survey, anthropometrically, a low [(<5%)[29]] prevalence of wasting, a low [(<10%)[29]] prevalence of being underweight and a medium [(20,0-29,9%)[29]] prevalence of stunting has been documented at the national level.

Nutritional status, however, varied considerably between urban and rural populations and among Provinces. The prevalence of wasting, although low [(<5%)[29]], varied from 0,9% in the Western Cape to 5.7% in North West to 7.5 % in the Northern Province and to 9.6% in the Northern Cape. The prevalence of being underweight varied from a low [(<10%)[29]] of 4.2% in Mpumalanga to a medium [(10.0 - 19.9)[29]] of 15% in the Northern Province and 15.3% in North West and to a high [(20.0-29.9)[29]] 23.7% in the Northern Cape, almost a six-fold difference. Similarly, there was almost a two-fold difference in the prevalence of stunting between the Western Cape (15%) and the Free State (30%), the latter being a high [(30,0-39,9%)[29]] prevalence. Previous studies [6,13,27] of preschool children have reported a prevalence of 16% and 29% for underweight and stunting, respectively, compared to 10% and 22% in the present survey. Furthermore, the study by the Regional Health Organisation of Southern Africa (RHOSA) on rural children reported a prevalence of 8% underweight and of 25% stunting in preschool children[11]. Previously available data, therefore, is in reasonable agreement with the average values of 10% underweight and of 22% of stunting found in the present study. Additionally, the findings of the present survey clearly indicate that the 1 – 3 year old age group is, indeed, the most severely affected having approximately a two-fold higher prevalence of stunting and of being underweight. Although a small, but consistent, overall tendency for a lower prevalence in some abnormal anthropometric parameters at the national level is noted and is welcome, the present findings indicate that malnutrition continues to be a significant problem in the country, especially in the rural areas as a whole and in the Northern Cape in particular. On the other side of the spectrum, at the national level, the prevalence of being overweight (6%) appears not to have changed when compared with the findings of the SAVACG survey[27] in 1995 (6.7%; SAVACG personal communication). Nevertheless, a two-fold higher prevalence (12%) has been seen in children of well-educated mothers living in urban areas as compared with the national average (6%).

In 1994, a national study on children starting school involving 364 magisterial districts, 3 347 primary schools and 97 790 children, reported that 9.0% of children were underweight and 13% were stunted[31]. The study included 12% of children who were younger than 6 years of age, 30% between 6 and 7 years and 31% between 7 and 8 years of age; these age groups partly overlap with those of the present study. The prevalence of being underweight or wasted in both studies (< -2SDs) is very similar (10% underweight and 4% wasted in this present study vs 9% and 3% respectively), whereas the prevalence of stunting (< -2SDs) is almost double in the present study (22% vs 13% in the school survey). Within the obvious time and age group limitations of such a comparison, it would appear that the prevalence of malnutrition in the country continues to be unacceptably high and is indeed a cause of grave concern. Importantly in the present survey, the younger (1 - 3 year olds) appear to be the more severely affected by stunting than the older children (7 – 9 year olds), a finding that has important implications in terms of formulating, prioritising, targeting and implementing intervention programmes.

In comparative terms (Table 4.33)[1], and within the acknowledged limitations of such comparisons, South African children in the age range of the present survey appear to have a more favourable nutritional status than children elsewhere in Africa, Central and South America and in the Indian peninsula.

However, although the average South African prevalence of anthropometric indices appears favourable, it is certainly no cause for complacency. It is, indeed, a cause of grave concern and it calls for immediate action, especially in those areas where the prevalence of stunting exceeds 20%, namely on commercial farms, tribal, rural, informal urban areas as well as seven of the nine Provinces. The latter, together with the presence of deficiencies of vitamin A and iron, represents a very considerable risk of infection, morbidity and mortality in the population studied. As such, the improvement of the nutritional status and health care services for young children should undoubtedly continue to be seen as a national priority, intensified and afforded the full benefits of the Department's Integrated Nutrition Programme.

The prevalence of stunting is known to reflect socioeconomic standards. It is also known that the most adverse impact of undernutrition on the growth of children occurs in those younger than 2 years of age[32,33]. The prevalence of stunting can be significantly reduced, but by no means eliminated[34-37], with improvements in socioeconomic conditions and better and more accessible health care facilities. This suggests that the country is likely to be faced with the problem of stunting for some significant number of years in the future. As such, the current intervention programmes of the Department, which appear to have been successful in preventing deterioration of the nutritional status of our children, should receive much greater priority and become more focused on the younger children in order to address this continuing problem on an urgent basis. In this regard, socioeconomic development is of paramount importance[32-37]; improvement of nutritional status is also significantly, if not equally, important[38,39]. Importantly though, food supplementation schemes are most likely to have maximal benefit, in terms of reversing stunting, when they are provided during the period of maximum growth deficits, namely to the very young children. For instance, each 100 Kcal/day in supplementary feeding during the first year of life is reported to be associated with approximately 9 mm in additional length gain as compared with 5 mm, 4 mm and no impact of linear growth at all when the same supplement is given during the second, third or fourth year of life, respectively[38]. Similarly[39], in a more severely malnourished population, each 170 Kcal/day supplementary feeding is associated with an additional growth of 2.8 cm, 1.7 cm and 1.1 cm in 1 - 2, 2 - 4 and 4 - 5 year old children, respectively.

It is insufficiently appreciated that the composition of the supplementary foods is as important as providing such foods[40]. Although adequate energy intake is important, its role is often overemphasised[41]; indeed, neither energy nor any of the known nutrients, on their own, have been shown to affect linear growth consistently[20]. Within the context of developing countries, it is generally accepted that an inadequate energy intake is likely to be associated with inadequate intake of other nutrients, especially micronutrients, as well as with poor dietary quality[40]. Recent evidence from a multinational (Mexico, Kenya and Egypt) longitudinal study[20] indicates that although stunting occurred soon after birth in all three countries, as it has also been shown to be the case in the present study, energy deficiency was a problem only in Kenya; all three populations studied, however, had poor dietary quality and multiple micronutrient deficiencies. The inclusion of those micronutrients, in the case of deficiency, known to adversely affect linear growth, therefore, should be included in any supplementary foods. Further in this regard and in the wider context, food fortification[42], among others, is one of the strategies that has been employed worldwide, with consistent success, in alleviating poor micronutrient status and deficiencies and thus improving the well being of populations at the national level, especially that of children.

In summary, the findings of the present national study indicate that one in ten of all children aged 1 – 9 years was underweight and just more than one in five was stunted. Furthermore, younger children (1 – 3 years of age) were most severely affected, as were those that lived in the rural areas and on commercial farms in particular. The level of maternal education was an important determinant for these nutritional disorders.

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