Research/Recherche

The development of MUAC-for-age reference data recommended by a WHO Expert Committee

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Low mid-upper-arm circumference (MUAC), determined on the basis of a fixed cut-off value, has commonly been used as a proxy for low weight-for-height (wasting). The use of a fixed cut-off value was based on the observation that MUAC showed small age- and sex-specific differences. However, in 1993, a WHO Expert Committee concluded that age independence is not reflected in the true pattern of mid-upper arm growth, recommended the use of MUAC-for-age, and presented age- and sex-specific MUAC reference data developed with observations obtained from a representative sample of children in the USA aged 6–59 months. In this article, we explain the methodology for the development of these data, present age- and sex-specific growth curves and tables and discuss the applications and limitations of MUAC as a nutritional indicator. To develop the reference data, estimates were first obtained for the mean and standard deviation of MUAC for each month of age using 7-month segmental regression equations; a 5th-degree and a 3rd-degree polynomial in age was then used to describe the mean and standard deviation, respectively, of MUAC-for age. These curves show important age-specific differences, and significant sex-specific differences for boys and girls <24 months of age. Correct interpretation of MUAC with regard to nutritional status requires the use of MUAC-for-age reference data such as those presented here.

Introduction

For many years, mid-upper-arm circumference (MUAC) has been used as an alternative indicator of nutritional status if the collection of height and weight measurements was difficult, such as during emergencies, famines, or refugee crises. In such cases, low MUAC, determined on the basis of a single cut-off value, has been used as a proxy for low weight-for-height (i.e. wasting). Comparisons of the two indicators, however, show that they are poorly correlated (*1*, *2*). Moreover, in community-based studies, MUAC appears to be a better predictor of childhood mortality than height- and weight-based anthropometric indicators (*3–6*). This has led to the proposal that MUAC should be used as an independent indicator for routine nutritional assessment.

The operational advantages of MUAC include the portability of measuring tapes and the fact that a single cut-off value (generally 12.5 cm or 13.0 cm) has been used for children <5 years of age. The use of a fixed cut-off value was based on the observation in the early 1960s that for normal, well-fed Polish children MUAC increased by only about 1 cm between the ages of 1 year and 4 years, and that there was a difference of only a few millimetres between boys and girls at most ages (*7*, *8*). However, the assumption that MUAC is age- and sex-independent in young children has recently been questioned, and it has been suggested that MUAC Z-scores that adjust for differences between age and sex are a more useful indicator of nutritional status (*9*, *10*).

In 1993, a WHO Expert Committee reviewed the scientific evidence underlying the use and interpretation of MUAC (*11*). The Committee examined mean MUAC data across ages from the National Center for Health Statistics (NCHS) sample of children in the USA, and for a cohort of Malawian children; for both populations MUAC increased by approximately 2 cm between 6 and 59 months of age.

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When a MUAC-for-age reference for both boys and girls was constructed from the NCHS data and applied to the Malawian children, important differences were observed between the age-specific prevalences of low MUAC when either MUAC-for-age Z-scores or a cut-off value of 13.0cm were used (*11*). A fixed cut-off value preferentially identified younger children as malnourished.

The Committee concluded that the assumption of age independence did not reflect the true pattern of mid-upper-arm growth and recommended that proper interpretation of MUAC required the use of age-specific reference data (*12*). In this article, we explain the methodology for the development of these data, present age- and sex-specific growth curves and tables and discuss the applications and limitations of MUAC as a nutritional indicator.

Methods

To construct the MUAC-for-age growth reference data, we used growth data for children 6–59 months of age from the first and second National Health and Nutrition Examination Surveys in the USA (NHANES I, NHANES II). Both NHANES I and NHANES II used a complex, multistage, probability-sampling design to obtain a representative sample of the non-institutionalized civilian population aged 6 months to 74 years in the USA. Detailed descriptions of the samples have been published previously (*13, 14*). Data from both surveys were combined in order to increase sample size. A total of 2310 measurements of MUAC for NHANES I and 3309 measurements for NHANES II were available for children aged 6–59 months. We verified that age- and sex-specific growth status were comparable in both surveys.

We estimated the mean and standard deviation (SD) of MUAC for each month of age by combining MUAC data for the relevant month of age with data for the 3 months before and 3 months after the age concerned.[a] A linear regression of the resulting 7-month segment of MUAC data by age provides a more stable estimate of the mean and SD of MUAC at the mid-point month than that based on the data for that month only. In using this segmental regression approach the sample size was effectively expanded by "borrowing" the MUAC values of children within ±3 months of age, without, however, assuming that there was no MUAC growth during the 7-month period. Mean MUAC for each month of age, as obtained from the segmental regression equations, and the 95% range of the MUAC by age regression were used to estimate the SD for each month of age. MUAC growth curves representing the mean and ±1, 2, and 3 SDs were constructed with the monthly estimates of the mean and SD of MUAC obtained from the regression equations. For each of the curves thus developed, a 5th-degree polynomial equation in age was used to describe the mean, and a 3rd-degree polynomial to describe the SD.

This approach assumes that the distribution of MUAC is normal and that MUAC growth within a 7-month period can be adequately characterized using a simple linear equation. The SD values of both sexes were not statistically different at the 5% level; thus we used the sex-combined SD value for all three curves in order to obtain more stable SD estimates. The reference data and growth curves were developed using the Centers for Disease Control and Prevention mainframe.

[a] Since no data were available for children younger than 6 months, for the ages 6, 7, and 8 months the MUAC data used were, respectively, those for 6–9 months, 6–10 months, and 6–11 months. For the upper end of the curves there were MUAC data available beyond 59 months.

Table 1: **Constant and coefficients of best-fit polynomial equations[a] for the mean and SD of MUAC-for-age[b]**

	Mean:			
Coefficient	Boys	Girls	Both sexes	SD
C_0	13.610	11.534	12.408	1.0566
C_1	2.9288×10^{1}	5.1060×10^{1}	4.2700×10^{1}	2.0731×10^{2}
C_2	-1.3705×10^{2}	-2.3408×10^{2}	-1.9924×10^{2}	-5.0945×10^{4}
C_3	3.3561×10^{4}	5.4240×10^{4}	4.7333×10^{4}	5.2768×10^{6}
C_4	-3.8818×10^{6}	-5.9797×10^{6}	-5.3372×10^{6}	—
C_5	1.7218×10^{8}	2.5431×10^{8}	2.3154×10^{8}	—

[a] MUAC-for-age Mean $= C_0 + C_1(\text{age}) + C_2(\text{age})^2 + C_3(\text{age})^3 + C_4(\text{age})^4 + C_5(\text{age})^5$; MUAC-for-age SD $= C_0 + C_1(\text{age}) + C_2(\text{age})^2 + C_3(\text{age})^3$.
[b] MUAC-for-age = mid-upper-arm-circumference-for-age.

Fig. 1. **MUAC-for-age growth reference curve for boys aged 6–59 months.**

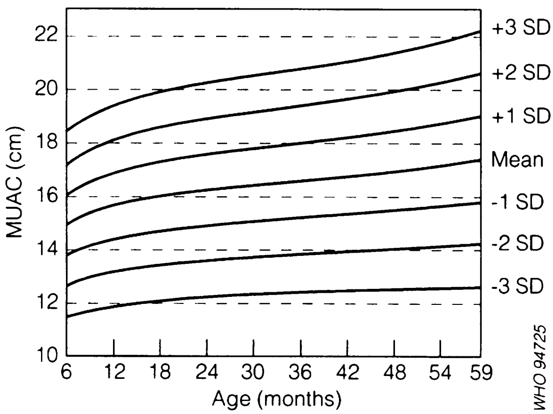


Fig. 2. **MUAC-for-age growth reference curve for girls aged 6–59 months.**

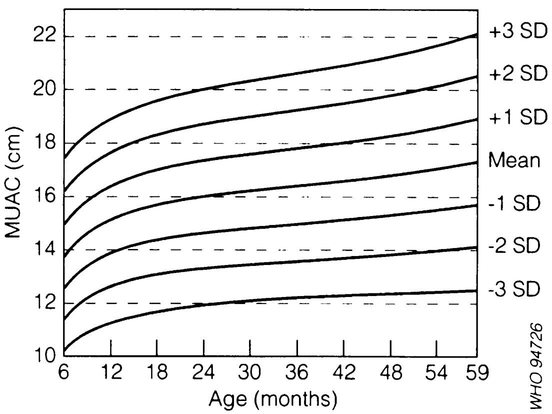
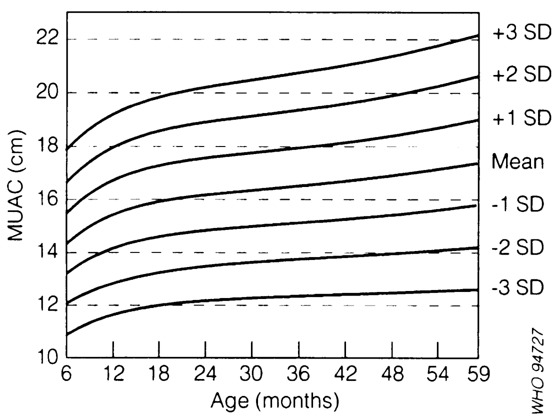


Fig. 3. **Combined MUAC-for-age growth reference curve for boys and girls aged 6–59 months.**



Results

The best-fit polynomial equations for the MUAC-for-age growth data are presented in Table 1. Figures 1–3 show sex-specific and sex-combined MUAC-for-age reference growth curves for children aged 6–59 months. Tables 2–4 present the numerical reference data. Although most of the variation in MUAC is captured by the sex-combined MUAC-for-age curves, there are none the less significant sex-specific differences for children <24 months of age.

Discussion

Data from both affluent and non-affluent populations show that MUAC is age dependent; this results in the overdiagnosis of wasting among younger children, and its underdiagnosis among older ones when a fixed cut-off value is used (*11*). This age-specific variability in MUAC would explain the poor correlation of low MUAC (determined relative to a fixed cut-off value) with low weight-for-height (*15*). This bias may also account for the good predictive value of low MUAC (determined relative to a fixed cut-off value) for mortality; younger children are more likely to have both lower MUAC and higher rates of mortality than older children. As shown by the Expert Committee's analyses, the superior performance of low MUAC as a predictor for mortality declined significantly after the adjustment of MUAC for age. In fact, the performance of unadjusted MUAC in predicting mortality was comparable to that of age, height, or weight indicators developed on the basis of fixed cut-off points (i.e. unadjusted for age) (*11*).

Recent data show that MUAC Z-scores that adjust for differences of age and sex are a more useful indicator of nutritional status than a fixed cut-off value. For example, among Bangladeshi children 12–59 months of age, the prevalence of undernutrition as determined by MUAC Z-scores was only marginally higher among girls than boys. In contrast, the use of a fixed cut-off value (12.5 cm) indicated that there was a markedly higher prevalence of undernutrition among girls. Differences according to age were also striking; a high proportion of children >3 years of age had low MUAC Z-scores, even though only very few of them had a MUAC value <12.5 cm (*9*). Although low MUAC Z-scores still showed younger children to be more often undernourished than older ones, undernutrition between 6 and 59 months of age was more evenly distributed, with a greater proportion of older children identified as undernourished, when cut-off values developed on the basis of MUAC-for-age Z-scores were used (*9, 11*).

Table 2: **MUAC-for-age reference data for boys aged 6–59 months**[a]

Age (months)	−4 SD	−3 SD	−2 SD	−1 SD	Mean	+1 SD	+2 SD	+3 SD
6	10.3	11.5	12.6	13.8	14.9	16.1	17.3	18.4
7	10.4	11.6	12.7	13.9	15.1	16.3	17.5	18.6
8	10.5	11.7	12.8	14.0	15.2	16.4	17.6	18.8
9	10.5	11.7	12.9	14.2	15.4	16.6	17.8	19.0
10	10.6	11.8	13.0	14.2	15.5	16.7	17.9	19.1
11	10.6	11.9	13.1	14.3	15.6	16.8	18.0	19.3
12	10.7	11.9	13.2	14.4	15.7	16.9	18.1	19.4
13	10.7	12.0	13.2	14.5	15.7	17.0	18.2	19.5
14	10.8	12.0	13.3	14.5	15.8	17.1	18.3	19.6
15	10.8	12.1	13.3	14.6	15.9	17.1	18.4	19.7
16	10.8	12.1	13.4	14.6	15.9	17.2	18.5	19.8
17	10.8	12.1	13.4	14.7	16.0	17.3	18.6	19.8
18	10.8	12.1	13.4	14.7	16.0	17.3	18.6	19.9
19	10.9	12.2	13.5	14.8	16.1	17.4	18.7	20.0
20	10.9	12.2	13.5	14.8	16.1	17.4	18.7	20.0
21	10.9	12.2	13.5	14.8	16.1	17.5	18.8	20.1
22	10.9	12.2	13.5	14.9	16.2	17.5	18.8	20.1
23	10.9	12.2	13.5	14.9	16.2	17.5	18.9	20.2
24	10.9	12.2	13.6	14.9	16.2	17.6	18.9	20.2
25	10.9	12.2	13.6	14.9	16.3	17.6	18.9	20.3
26	10.9	12.3	13.6	14.9	16.3	17.6	19.0	20.3
27	10.9	12.3	13.6	15.0	16.3	17.7	19.0	20.4
28	10.9	12.3	13.6	15.0	16.3	17.7	19.1	20.4
29	10.9	12.3	13.7	15.0	16.4	17.7	19.1	20.4
30	10.9	12.3	13.7	15.0	16.4	17.8	19.1	20.5
31	11.0	12.3	13.7	15.1	16.4	17.8	19.2	20.5
32	11.0	12.3	13.7	15.1	16.5	17.8	19.2	20.6
33	11.0	12.4	13.7	15.1	16.5	17.9	19.2	20.6
34	11.0	12.4	13.8	15.1	16.5	17.9	19.3	20.6
35	11.0	12.4	13.8	15.2	16.5	17.9	19.3	20.7
36	11.0	12.4	13.8	15.2	16.6	18.0	19.3	20.7
37	11.0	12.4	13.8	15.2	16.6	18.0	19.4	20.8
38	11.0	12.4	13.8	15.2	16.6	18.0	19.4	20.8
39	11.1	12.5	13.9	15.3	16.7	18.1	19.5	20.9
40	11.1	12.5	13.9	15.3	16.7	18.1	19.5	20.9
41	11.1	12.5	13.9	15.3	16.7	18.1	19.6	21.0
42	11.1	12.5	13.9	15.4	16.8	18.2	19.6	21.0
43	11.1	12.5	14.0	15.4	16.8	18.2	19.7	21.1
44	11.1	12.5	14.0	15.4	16.8	18.3	19.7	21.1
45	11.1	12.6	14.0	15.4	16.9	18.3	19.8	21.2
46	11.1	12.6	14.0	15.5	16.9	18.4	19.8	21.3
47	11.1	12.6	14.0	15.5	17.0	18.4	19.9	21.3
48	11.1	12.6	14.1	15.5	17.0	18.4	19.9	21.4
49	11.1	12.6	14.1	15.6	17.0	18.5	20.0	21.4
50	11.1	12.6	14.1	15.6	17.1	18.5	20.0	21.5
51	11.1	12.6	14.1	15.6	17.1	18.6	20.1	21.6
52	11.1	12.6	14.1	15.6	17.1	18.6	20.1	21.6
53	11.1	12.6	14.1	15.7	17.2	18.7	20.2	21.7
54	11.1	12.6	14.2	15.7	17.2	18.7	20.2	21.8
55	11.1	12.6	14.2	15.7	17.2	18.8	20.3	21.8
56	11.1	12.6	14.2	15.7	17.3	18.8	20.4	21.9
57	11.1	12.6	14.2	15.8	17.3	18.9	20.4	22.0
58	11.1	12.6	14.2	15.8	17.3	18.9	20.5	22.1
59	11.1	12.6	14.2	15.8	17.4	19.0	20.6	22.2

[a] Some data previously published in WHO Technical Report Series, No. 854 (ref. *11*).

Table 3: **MUAC-for-age reference data for girls aged 6–59 months**[a]

Age (months)	−4 SD	−3 SD	−2 SD	−1 SD	Mean	+1 SD	+2 SD	+3 SD
6	9.2	10.4	11.5	12.7	13.9	15.0	16.2	17.4
7	9.4	10.6	11.8	13.0	14.1	15.3	16.5	17.7
8	9.6	10.8	12.0	13.2	14.4	15.6	16.8	18.0
9	9.8	11.0	12.2	13.4	14.6	15.8	17.0	18.2
10	9.9	11.1	12.3	13.6	14.8	16.0	17.2	18.4
11	10.0	11.3	12.5	13.7	15.0	16.2	17.4	18.6
12	10.1	11.4	12.6	13.9	15.1	16.4	17.6	18.8
13	10.2	11.5	12.7	14.0	15.2	16.5	17.7	19.0
14	10.3	11.6	12.8	14.1	15.4	16.6	17.9	19.2
15	10.4	11.7	12.9	14.2	15.5	16.7	18.0	19.3
16	10.4	11.7	13.0	14.3	15.6	16.8	18.1	19.4
17	10.5	11.8	13.1	14.4	15.7	16.9	18.2	19.5
18	10.5	11.8	13.1	14.4	15.7	17.0	18.3	19.6
19	10.6	11.9	13.2	14.5	15.8	17.1	18.4	19.7
20	10.6	11.9	13.2	14.5	15.8	17.2	18.5	19.8
21	10.6	11.9	13.3	14.6	15.9	17.2	18.5	19.8
22	10.7	12.0	13.3	14.6	15.9	17.3	18.6	19.9
23	10.7	12.0	13.3	14.7	16.0	17.3	18.6	20.0
24	10.7	12.0	13.4	14.7	16.0	17.4	18.7	20.0
25	10.7	12.0	13.4	14.7	16.1	17.4	18.7	20.1
26	10.7	12.1	13.4	14.7	16.1	17.4	18.8	20.1
27	10.7	12.1	13.4	14.8	16.1	17.5	18.8	20.2
28	10.7	12.1	13.4	14.8	16.1	17.5	18.9	20.2
29	10.7	12.1	13.5	14.8	16.2	17.5	18.9	20.3
30	10.8	12.1	13.5	14.8	16.2	17.6	18.9	20.3
31	10.8	12.1	13.5	14.9	16.2	17.6	19.0	20.3
32	10.8	12.1	13.5	14.9	16.3	17.6	19.0	20.4
33	10.8	12.2	13.5	14.9	16.3	17.7	19.0	20.4
34	10.8	12.2	13.6	14.9	16.3	17.7	19.1	20.5
35	10.8	12.2	13.6	15.0	16.3	17.7	19.1	20.5
36	10.8	12.2	13.6	15.0	16.4	17.8	19.2	20.5
37	10.8	12.2	13.6	15.0	16.4	17.8	19.2	20.6
38	10.9	12.2	13.6	15.0	16.4	17.8	19.2	20.6
39	10.9	12.3	13.7	15.1	16.5	17.9	19.3	20.7
40	10.9	12.3	13.7	15.1	16.5	17.9	19.3	20.7
41	10.9	12.3	13.7	15.1	16.6	18.0	19.4	20.8
42	10.9	12.3	13.8	15.2	16.6	18.0	19.4	20.8
43	10.9	12.4	13.8	15.2	16.6	18.1	19.5	20.9
44	10.9	12.4	13.8	15.2	16.7	18.1	19.5	21.0
45	11.0	12.4	13.8	15.3	16.7	18.1	19.6	21.0
46	11.0	12.4	13.9	15.3	16.7	18.2	19.6	21.1
47	11.0	12.4	13.9	15.3	16.8	18.2	19.7	21.2
48	11.0	12.4	13.9	15.4	16.8	18.3	19.8	21.2
49	11.0	12.5	13.9	15.4	16.9	18.3	19.8	21.3
50	11.0	12.5	14.0	15.4	16.9	18.4	19.9	21.4
51	11.0	12.5	14.0	15.5	17.0	18.4	19.9	21.4
52	11.0	12.5	14.0	15.5	17.0	18.5	20.0	21.5
53	11.0	12.5	14.0	15.5	17.0	18.6	20.1	21.6
54	11.0	12.5	14.0	15.6	17.1	18.6	20.1	21.7
55	11.0	12.5	14.1	15.6	17.1	18.7	20.2	21.7
56	11.0	12.5	14.1	15.6	17.2	18.7	20.3	21.8
57	11.0	12.5	14.1	15.7	17.2	18.8	20.3	21.9
58	11.0	12.5	14.1	15.7	17.3	18.8	20.4	22.0
59	11.0	12.5	14.1	15.7	17.3	18.9	20.5	22.1

[a] Some data previously published in WHO Technical Report Series, No. 854 (ref. *11*).

Table 4: **Combined MUAC-for-age reference data for boys and girls aged 6–59 months**[a]

Age (months)	−4 SD	−3 SD	−2 SD	−1 SD	Mean	+1 SD	+2 SD	+3 SD
6	9.7	10.9	12.0	13.2	14.3	15.5	16.7	17.8
7	9.9	11.0	12.2	13.4	14.6	15.7	16.9	18.1
8	10.0	11.2	12.4	13.6	14.8	16.0	17.2	18.3
9	10.1	11.3	12.5	13.7	14.9	16.2	17.4	18.6
10	10.2	11.5	12.7	13.9	15.1	16.3	17.5	18.8
11	10.3	11.6	12.8	14.0	15.2	16.5	17.7	18.9
12	10.4	11.7	12.9	14.1	15.4	16.6	17.9	19.1
13	10.5	11.7	13.0	14.2	15.5	16.7	18.0	19.2
14	10.5	11.8	13.1	14.3	15.6	16.8	18.1	19.4
15	10.6	11.9	13.1	14.4	15.7	16.9	18.2	19.5
16	10.6	11.9	13.2	14.5	15.8	17.0	18.3	19.6
17	10.7	12.0	13.2	14.5	15.8	17.1	18.4	19.7
18	10.7	12.0	13.3	14.6	15.9	17.2	18.5	19.8
19	10.7	12.0	13.3	14.6	15.9	17.2	18.5	19.8
20	10.7	12.1	13.4	14.7	16.0	17.3	18.6	19.9
21	10.8	12.1	13.4	14.7	16.0	17.3	18.7	20.0
22	10.8	12.1	13.4	14.7	16.1	17.4	18.7	20.0
23	10.8	12.1	13.4	14.8	16.1	17.4	18.8	20.1
24	10.8	12.1	13.5	14.8	16.1	17.5	18.8	20.1
25	10.8	12.2	13.5	14.8	16.2	17.5	18.8	20.2
26	10.8	12.2	13.5	14.9	16.2	17.5	18.9	20.2
27	10.8	12.2	13.5	14.9	16.2	17.6	18.9	20.3
28	10.8	12.2	13.5	14.9	16.3	17.6	19.0	20.3
29	10.8	12.2	13.6	14.9	16.3	17.6	19.0	20.4
30	10.9	12.2	13.6	14.9	16.3	17.7	19.0	20.4
31	10.9	12.2	13.6	15.0	16.3	17.7	19.1	20.4
32	10.9	12.2	13.6	15.0	16.4	17.7	19.1	20.5
33	10.9	12.3	13.6	15.0	16.4	17.8	19.1	20.5
34	10.9	12.3	13.7	15.0	16.4	17.8	19.2	20.6
35	10.9	12.3	13.7	15.1	16.4	17.8	19.2	20.6
36	10.9	12.3	13.7	15.1	16.5	17.9	19.3	20.6
37	10.9	12.3	13.7	15.1	16.5	17.9	19.3	20.7
38	10.9	12.3	13.7	15.1	16.5	17.9	19.3	20.7
39	11.0	12.4	13.8	15.2	16.6	18.0	19.4	20.8
40	11.0	12.4	13.8	15.2	16.6	18.0	19.4	20.8
41	11.0	12.4	13.8	15.2	16.6	18.1	19.5	20.9
42	11.0	12.4	13.8	15.3	16.7	18.1	19.5	20.9
43	11.0	12.4	13.9	15.3	16.7	18.1	19.6	21.0
44	11.0	12.5	13.9	15.3	16.8	18.2	19.6	21.1
45	11.0	12.5	13.9	15.4	16.8	18.2	19.7	21.1
46	11.1	12.5	13.9	15.4	16.8	18.3	19.7	21.2
47	11.1	12.5	14.0	15.4	16.9	18.3	19.8	21.2
48	11.1	12.5	14.0	15.5	16.9	18.4	19.8	21.3
49	11.1	12.5	14.0	15.5	17.0	18.4	19.9	21.4
50	11.1	12.6	14.0	15.5	17.0	18.5	20.0	21.4
51	11.1	12.6	14.1	15.5	17.0	18.5	20.0	21.5
52	11.1	12.6	14.1	15.6	17.1	18.6	20.1	21.6
53	11.1	12.6	14.1	15.6	17.1	18.6	20.1	21.6
54	11.1	12.6	14.1	15.6	17.2	18.7	20.2	21.7
55	11.1	12.6	14.1	15.7	17.2	18.7	20.3	21.8
56	11.1	12.6	14.1	15.7	17.2	18.8	20.3	21.9
57	11.1	12.6	14.1	15.7	17.3	18.8	20.4	21.9
58	11.1	12.6	14.2	15.7	17.3	18.9	20.5	22.0
59	11.1	12.6	14.2	15.8	17.3	18.9	20.5	22.1

[a] Some data previously published in WHO Technical Report Series, No. 854 (ref. *11*).

These findings relating to the use of MUAC-for-age underline the need to evaluate more thoroughly the less-commonly used indicator MUAC-for-height, measured with the QUAC stick (*16*), which is a simple tool for adjusting MUAC cut-off values according to height. MUAC-for-height may prove to be a useful proxy for MUAC-for-age when accurate age information is not available (*17*). The Centers for Disease Control and Prevention and WHO are currently developing MUAC-for-height Z-scores for preschool children on the basis of the data collected for NHANES I and NHANES II.

Although there are advantages to using MUAC with a single cut-off value, using MUAC-for-age reference data in the field is no more difficult than using weight-for-height reference data, a common feature of rapid nutritional assessment surveys. Moreover, the equipment required to measure MUAC is simpler and less expensive than that required for measuring weight and height. A disadvantage of using MUAC-for-age in field surveys, however, is the need to determine age accurately, which can be difficult. Another limitation is the relatively large variability in MUAC measurements made by different workers, indicating the need for careful training and standardization.

Although low MUAC is confounded by age when a fixed cut-off value is used, it is still appropriate for certain applications. For example, in some settings it may be desirable to use a more sensitive, less specific indicator for young children in view of their higher risk of morbidity and mortality. However, the proper interpretation of MUAC regarding nutritional status, or its causal relationship with functional outcomes, requires the use of MUAC-for-age reference data.

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Résumé

Etablissement des données de référence pour l'indicateur MUAC/âge recommandées par un Comité d'experts de l'OMS

Depuis des années, le périmètre brachial à mi-hauteur (MUAC) est utilisé comme indicateur de remplacement pour l'état nutritionnel si la mesure du poids et de la taille est difficile à réaliser. Un MUAC faible, estimé par rapport à une valeur seuil établie pour tous les enfants de moins de cinq ans, est utilisé en remplacement de l'indica-teur poids/taille pour évaluer l'émaciation. L'emploi d'un seuil fixe est fondé sur l'observation selon laquelle le MUAC augmente très peu entre un et quatre ans, et ne présente qu'une différence négligeable entre filles et garçons. Ces questions ont été examinées en 1993 par le Comité OMS d'experts sur l'utilisation et l'interprétation de l'anthropométrie, qui a conclu que le postulat de l'indépendance du MUAC par rapport à l'âge ne reflète pas réellement la croissance au niveau du bras.

Pour construire une courbe de référence pour l'indicateur MUAC/âge nous avons utilisé des données classées par sexe recueillies chez des enfants de 6 à 59 mois au cours des première et deuxième enquêtes nationales sur la santé et la nutrition (National Health and Nutrition Examination Surveys) aux Etats-Unis d'Amérique. Suivant une méthode d'estimation à plusieurs degrés, la moyenne et l'écart type du MUAC/âge ont été calculés, et une relation polynomiale avec l'âge a été utilisée pour ajuster les courbes de croissance lissées.

Les courbes obtenues montrent d'importantes différences en fonction de l'âge et du sexe, notamment chez les enfants de moins de 24 mois. L'utilisation d'un seuil fixe pour déterminer les valeurs faibles du MUAC surestime systématiquement la prévalence de la malnutrition chez les jeunes enfants et la sous-estime chez les enfants plus âgés. Lorsqu'on recherche un indicateur plus sensible et moins spécifique de la malnutrition chez les jeunes enfants, on peut encore utiliser un seuil fixe, mais l'interprétation du MUAC du point de vue de l'état nutritionnel, ou en tant que facteur causal de troubles fonctionnels, exige l'utilisation de données de référence telles que celles qui sont présentées ici.

L'utilisation du MUAC a des répercussions importantes sur l'évaluation rapide du bilan nutritionnel, car cet indicateur est plus facile à mesurer que la taille et le poids. De plus, dans les cas où il n'existe pas de données fiables sur l'âge, il est possible d'utiliser le MUAC/taille comme indicateur. L'OMS et les Centers for Disease Control and Prevention (Etats-Unis d'Amérique) établissent actuellement des données de référence pour le rapport MUAC/taille dans cette optique.

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