Risk Factors for Early Childhood Malnutrition in Uganda

Joyce K. Kikafunda, PhD*; Ann F. Walker, PhD‡; David Collett, PhD§; and James K. Tumwine, MBChB‖

ABSTRACT. ***Objective.*** **To assess the dietary and environmental factors influencing stunting and other signs of poor nutritional status of children <30 months of age in a central Ugandan community, whose main dietary staples are banana (matoki) and maize.**

Methods. **The study was a cross-sectional survey using stratified multistage random sampling to select households with a child <30 months of age in rural and semi-urban environments. A questionnaire was administered to mothers of 261 infants and toddlers in their home setting. Their health status was assessed by clinical examination and anthropometric measurements (mid-upper arm circumference [MUAC], weight, and supine length).**

Results. **A large minority (21.5%) of the children surveyed were found in poor health after clinical examination: 3.8% being classified as suffering from kwashiorkor and 5.7% with marasmus. A high proportion of children were stunted (23.8%), underweight (24.1%), or had low MUAC (21.6%). Although rural living, poor health, the use of unprotected water supplies, lack of charcoal as fuel, lack of milk consumption, and lack of personal hygiene were shown as risk factors for marasmus and underweight, different factors were found to be associated with risk of stunting and low MUAC, despite these three parameters being significantly correlated. For stunting the risk factors were: age of the child, poor health, prolonged breastfeeding (from >18 months to <24 months), low socioeconomic status of the family, poor education of the mother of infants <12 months, lack of paraffin as fuel, consumption of food of low energy density (<350 kcal/100 g dry matter), presence of eye pathology, and consumption of small meals. Risk factors for low MUAC were poor health, lack of meat and cow's milk consumption, low intake of energy from fat, and less well educated and older mothers. Food taboos had no influence on any of the anthropometric measurements. Although 93.1% of the children had been immunized against tuberculosis, polio, diphtheria, and measles and showed better general health than children who were not immunized, there was a high prevalence of infection in the week preceding the survey interview, including diarrhea (23.0%), malaria (32.3%), or cough/influenza (72.8%).**

Conclusions. **This first account of dietary and environmental risk factors involved in the etiology of early childhood malnutrition in Uganda indicates differences in risk factors for marasmus and underweight compared with stunting and low MUAC. The high prevalence of malnutrition and current infection of children in this survey suggests poor immune function as a result of inadequate nutrition.** ***Pediatrics*** **1998;102(4). URL: http://www.pediatrics.org/cgi/content/full/102/4/e45;** ***infection, malnutrition, risk factors, stunting, survey, Uganda.***

ABBREVIATIONS. MUAC, mid-upper arm circumference; PEM, protein-energy malnutrition; SD, standard deviation.

From the *Department of Food Science and Technology, Makerere University, Kampala, Uganda; the ‡Hugh Sinclair Unit of Human Nutrition, Department of Food Science and Technology, the University of Reading, Whiteknights, Reading, United Kingdom; the §Department of Applied Statistics, the University of Reading, Reading, United Kingdom; and the ‖Department of Paediatrics and Child Health, Makerere University Medical School, Kampala, Uganda.

Received for publication Oct 13, 1997; accepted Apr 21, 1998.

Reprint requests to (A.F.W.) Hugh Sinclair Unit of Human Nutrition, Department of Food Science and Technology, the University of Reading, PO Box 226, Whiteknights, Reading RG6 6AP, United Kingdom.

Nutrition and health reports in Uganda have indicated that although the country is well endowed with adequate food supplies, a large proportion of children <5 years of age are malnourished.[1] The 1988/1989 Uganda Demographic and Health Survey showed that almost half of the children <5 years of age were stunted (45.5%) and almost one quarter were underweight (23%). The consequences of long-term nutritional deprivation are many and complex but ultimately culminate in ill health and death. It has been reported that ~60% of all deaths of children <5 years of age in Uganda are directly or indirectly attributable to malnutrition.[2] Although the causes of malnutrition are complex and multidisciplinary, dietary and environmental factors do play a major role. It has been reported that dietary factors,[3–5] factors concerning the mother,[6,7] and socioeconomic/environmental factors[8,9] may contribute to the risk of malnutrition in children in developing countries. A cross-sectional study-survey was, therefore, undertaken to determine the nutritional status of infants and young children (0–30 months of age) in the banana/maize zone of Central Uganda and to assess the dietary and related factors influencing the nutritional status of the children.

METHODS

Study Participants

Study participants were infants and young children, age 0 to 30 months, from Busimbi subcounty in Mityana county, Mubende district, Central Uganda. Mubende district was selected because of the dominant use of starchy staples [green cooking banana (locally known as matoki), cassava, potatoes, sweet potatoes, and maize] in weaning foods; staples well known for their high dietary bulk and low energy density. Stratified multistage random sampling was used to select the primary sampling units—the households. A household was defined as a group of people living, cooking, and eating together. Eighteen villages (clusters) were randomly selected from 5 parishes in Busimbi subcounty and all the households with a child <30 months of age had an equal chance of participating. A small sample of 3 clusters from Mityana town, representing the semi-urban environment, was also studied. A total of 261 children, 183 (70%) from rural areas and 78 (30%) from semi-urban environments, was studied.

Methods of Investigation

A comprehensive, precoded questionnaire was validated by the jury method[7] and piloted before the study in a similar setting. The questionnaires were administered to the respondents, preferably the mothers of the children, in their home settings by the principal researcher and assistants who trained following published guidelines.[10] The questionnaire was translated into the local languages at the time of administration. The age of the children, to the nearest month, was obtained through birth certificates and health cards, taking precautions to minimize field errors.[11]

Nutritional Status Assessment

The health of the children was assessed by clinical examination. The presence of edema was determined by the pitting method.[12] The presence of diarrhea, measles, malaria, or cough/influenza was assessed according to symptoms of the child in the week before the interview as described by the mother. Because this estimate of disease was unsubstantiated by laboratory analyses, only data for diarrhea were subjected to statistical analysis, although the symptoms associated with the other diseases are commonly known throughout Uganda. The height, weight, and mid-upper arm circumference (MUAC) were measured following recommendations.[10,12–14] Weight measurements were taken to the nearest 0.1 kg using a standardized 25 kg Salter Spring Balance (Salter Weight-Tronix Ltd, West Bromwich, West Midlands, UK). Measurements of supine or recumbent length were taken to the nearest 0.1 cm using the Short Infant/Child Height Measuring Board (Short Productions, Woonsocket, RI). The mid-upper point of the child's left arm was located by measuring the distance between the tip of the shoulder blade and the tip of the elbow and dividing the distance by two. MUAC was measured using a nonstretch, tear-resistant Insertion Tape supplied by TALC (Teaching Aids at Low Cost, St Albans, UK).

Dietary Assessment

The children's diet was assessed through a variety of methods; a diet history questionnaire, a 24-hour food recall, and a food frequency questionnaire, all of which were incorporated into the main questionnaire. Duplicate samples of ready-to-feed weaning foods were requested from the mothers during the interviews, these foods were dried and later analyzed for nutrient content and energy density. These samples were collected and analyzed individually and used as a proxy for usual diet.

Data Analysis

The dataset comprised 261 observations with 378 variables and was analyzed with SAS (Statistical Analysis System; SAS Institute, Inc, Cary, NC). Two-way and three-way cross-tabulations were performed on some selected variables (bivariate analyses). Statistical significance was determined using Pearson's χ^2 test. Correlation analysis was done using Pearson correlation coefficients. The risk factors for malnutrition of the children were further investigated using logistic regression analysis[15] using the Genstat package (Numerical Algorithms Group, Oxford, UK).

RESULTS AND DISCUSSION

The Health Status of the Children

Most of the children (93.1%) were reported as immunized and of these, 81.6% had immunization cards. Cross-tabulation showed that immunized children had significantly ($P = .014$) better general health than children who were not immunized. The area of residence (rural/urban) had a significant ($P = .004$) influence on the immunization status of the children with all the children from the urban areas having been immunized. Children from dirty households and those whose families obtained water from unprotected sources had a lower ($P = .042$ and $P = .007$, respectively) prevalence of immunization than more fortunate children.

Diarrheal diseases kill an estimated 3 million children each year in developing countries.[16] Diarrhea prevalence was high among the children studied, with 23.0% of the children having had an episode of diarrhea during the week preceding the interview. In cross-tabulations, children who had malaria or measles in the week preceding the interview had significantly ($P \leq .0001$ and $P = .025$, respectively) greater chances of having diarrhea than children who had not had these illnesses. Proportionately, children from the urban areas had significantly ($P = .051$) greater prevalence of diarrhea in the week preceding the study-survey than children from the rural areas.

Malaria kills an estimated 0.8 million children in Africa alone.[16] In the week preceding the interview, 32.2% of the children had had an episode of malaria. Measles kills an estimated 1 million children per year,[16] and precipitates the onset of malnutrition.[17] However, only 5.7% of the children in this study had had measles, although 72.8% had had cough and/or influenza in the week preceding the study.

The Nutritional Status of the Children

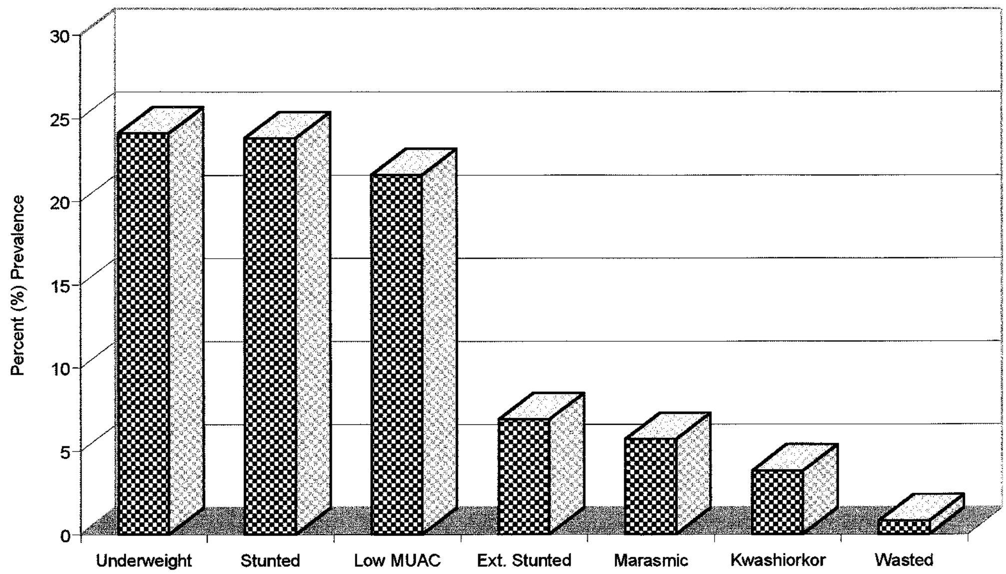
Growth and development of children <5 years of age are influenced more by environmental factors, particularly diet, than by genetic or ethnic origins.[18,19] Hence, an international reference population was used to assess the nutritional status of the children in this study.[20]

Prevalence of Kwashiorkor

Kwashiorkor is one of the most severe forms of protein-energy malnutrition (PEM) in children in developing countries. The condition is aggravated by repeated infections, especially diarrheal diseases. Edema must be present before a nutritional deficiency is classified as kwashiorkor.[21,22] On this basis, only 10 children (3.8% of the total sample) were classified as having kwashiorkor (Fig 1), which was insufficient for detailed cross-examination. Although the total number of children of the mother had no significant influence on the rate of kwashiorkor, children whose mothers had three children <5 years of age had more ($P = .019$) kwashiorkor than those whose mothers had two children in the same age range.

Prevalence of Marasmus

Marasmus was defined in this study as a weight-for-age of <3 standard deviations (SD) from the mean of the reference population for weight-for-age according to gender and with no visible edema. Fifteen children (5.7% of the total sample) were found to be marasmic (Fig 1), an insufficient number to allow extensive cross-examination. Nevertheless, it was found that children classified as unhealthy by clinical examinations had a higher incidence ($P \leq .0001$) of marasmus than those classified as healthy (19.6% vs 2.0%, respectively), both in rural and urban areas. Overall, children from rural areas had a higher incidence of marasmus ($P = .043$) than those from urban areas. When area of residence was controlled



[1] n=261 except for MUAC where n=208

Fig 1. Prevalence of malnutrition among 261 Ugandan children (n = 261 except for mid-upper arm circumference (MUAC) where n = 208).

for, it was found that rural children who had had an episode of diarrhea in the week preceding the survey had greater (P = .023) incidence of marasmus and the condition was more prevalent (P = .039) in twins than singletons.

The fat content of the weaning foods marginally (P = .050) influenced the marasmus status of the children, but none of the urban children whose food supplied >15% of energy from fat was marasmic. Children who had never consumed cow's milk had a higher incidence (P = .004) of marasmus than children who were milk consumers even in rural areas, and no marasmus was found among children from meat-eating households. Families who used water from protected sources and those who used charcoal as their main source of fuel had significantly (P = .028, P = .038, respectively) lower rates of marasmus among their children than their less fortunate counterparts.

Prevalence of Low MUAC

The MUAC of 208 of the younger children was measured. Children were classified as having low MUAC if measurements were smaller than 135 mm. Low MUAC was found in 21.6% of the children (17.2 of the total sample). There was a positive and significant correlation between MUAC and height (r = 0.334, $P \leq .0001$) and MUAC and weight (r = 0.680, P = .004). However, the correlation between MUAC and age, although positive, was not significant (r = 0.07, P = .304), emphasizing the age-independent nature of the MUAC index. Vella,[23] working in southwestern Uganda, found that low MUAC was the most sensitive predictor of mortality among the children in a 2-year prospective study. Siddique and Abengowe[24] found that the prevalence of low MUAC among rural children (n = 561) in the savanna belt of Nigeria, correlated significantly with anthropometric indicators.

Cross-tabulation showed that general health significantly ($P \leq .0001$) influenced the MUAC: those children classified as healthy had higher MUAC in both rural and urban areas. Children who had never consumed cow's milk had significantly (P = .006) higher rates of low MUAC, especially in rural areas. Families (both rural and urban) whose diet regularly included meat and urban families who derived >25% of their energy from fat had no child with low MUAC. The age of the mother had a significant (P = .005) influence on the MUAC of the child, with children of older mothers having proportionately higher rates of low MUAC. After controlling for area of residence, education of the mother became significant (P = .006) for MUAC, with none of urban mothers who had completed the primary level of education having a child with low MUAC. The occupation of the mother had a significant (P = .046) effect on MUAC status with more children of housewives having lowest MUAC than those of women with other occupations.

Prevalence of Stunting

The term "stunting" was introduced by J. C. Waterlow[25] in the 1970s to describe the linear growth retardation that results in children being very short for age as a result of prolonged nutritional deprivation coupled with repeated infections. Stunting, sometimes known as chronic malnutrition, is a very serious type of malnutrition in that it develops slowly throughout time before it is evident. When the majority of the children in a community are stunted the problem may not be obvious without height measurement matched against age. Uganda has been reported to have one of the highest rates of childhood stunting in Africa.[26–28]

In this study, the World Health Organization[20] recommended classification of stunting using the United States National Center for Health Statistics reference population was adopted. A child was classified as stunted if his/her height was 2 SD or more below the median of the reference population for height-for-age and gender. Although children <2 years of age had their supine (recumbent) length measured, the word height is used here to refer to both standing and supine length. Nearly a quarter of the children (23.8%) were short for age (Fig 1) and 6.9% were extremely stunted (>3 SD below the reference). Figures 2A and 2B show the height-for-age of girls and boys, respectively, showing values for all children to be below the median reference at all ages. These findings are in agreement with reports of other workers in Uganda.[2,8]

Prevalence of Underweight

Children were classified as underweight if <2 SD of the mean reference value (United States National Center for Health Statistics reference population[20]) for weight-for-age and gender; by this criteria, 24.1% were underweight (Fig 1). Figures 3A and 3B show the mean weight-for-age of the children at all the ages studied and illustrates, again, how the weights of the children remained below the reference median throughout the age range studied for both girls and boys.

Prevalence of Wasting

A child whose weight-for-height measurements were <2 SD of the median of a reference population for weight-for-height and gender was classified as wasted. Wasting is usually used as a measure of recent nutritional problems especially after an illness, particularly diarrhea, but in this study only 2 (0.8% of total sample) children were affected (Fig 1).

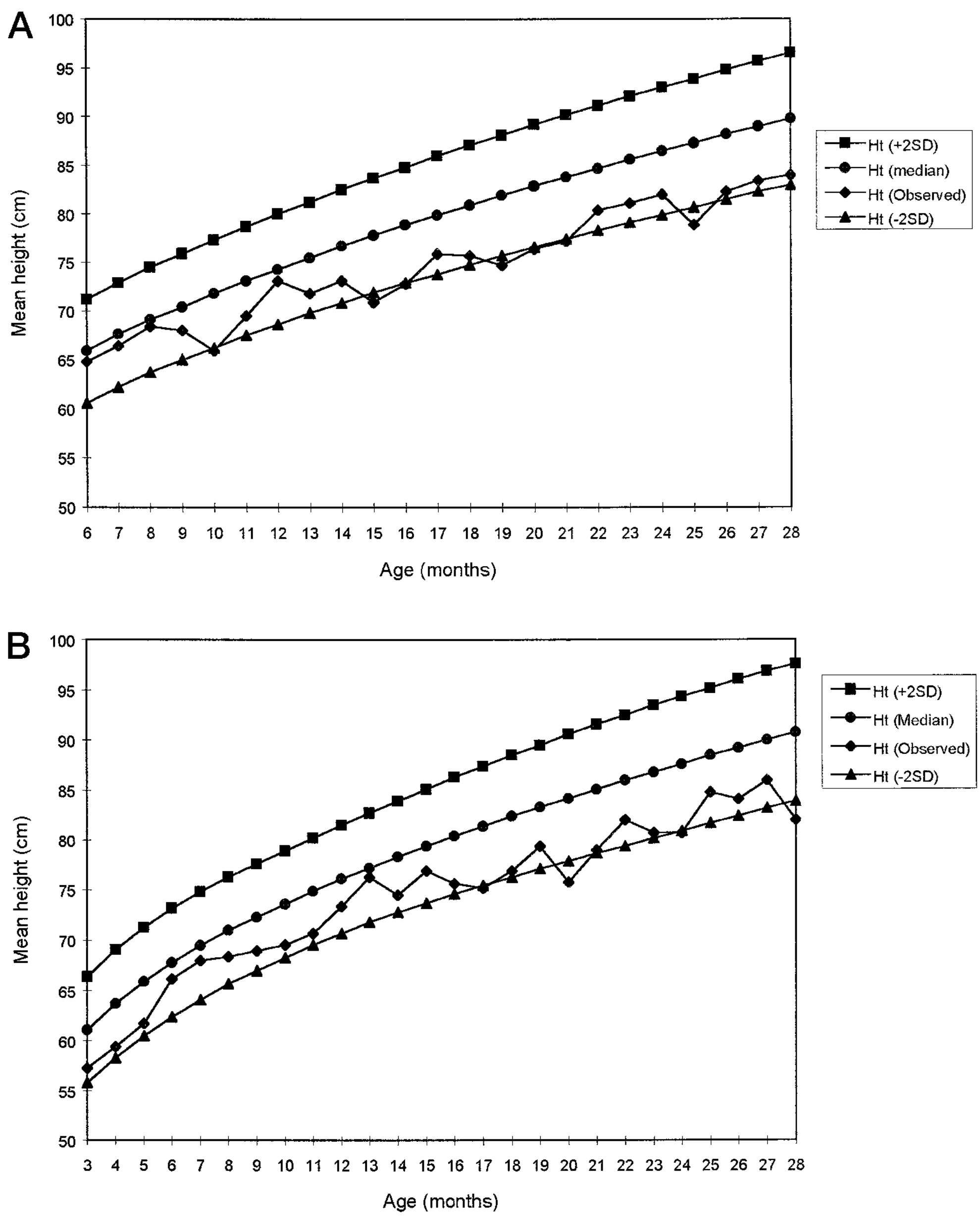


Fig 2. A, Height-for-age of girls compared with reference. B, Height-for-age of boys compared with reference.

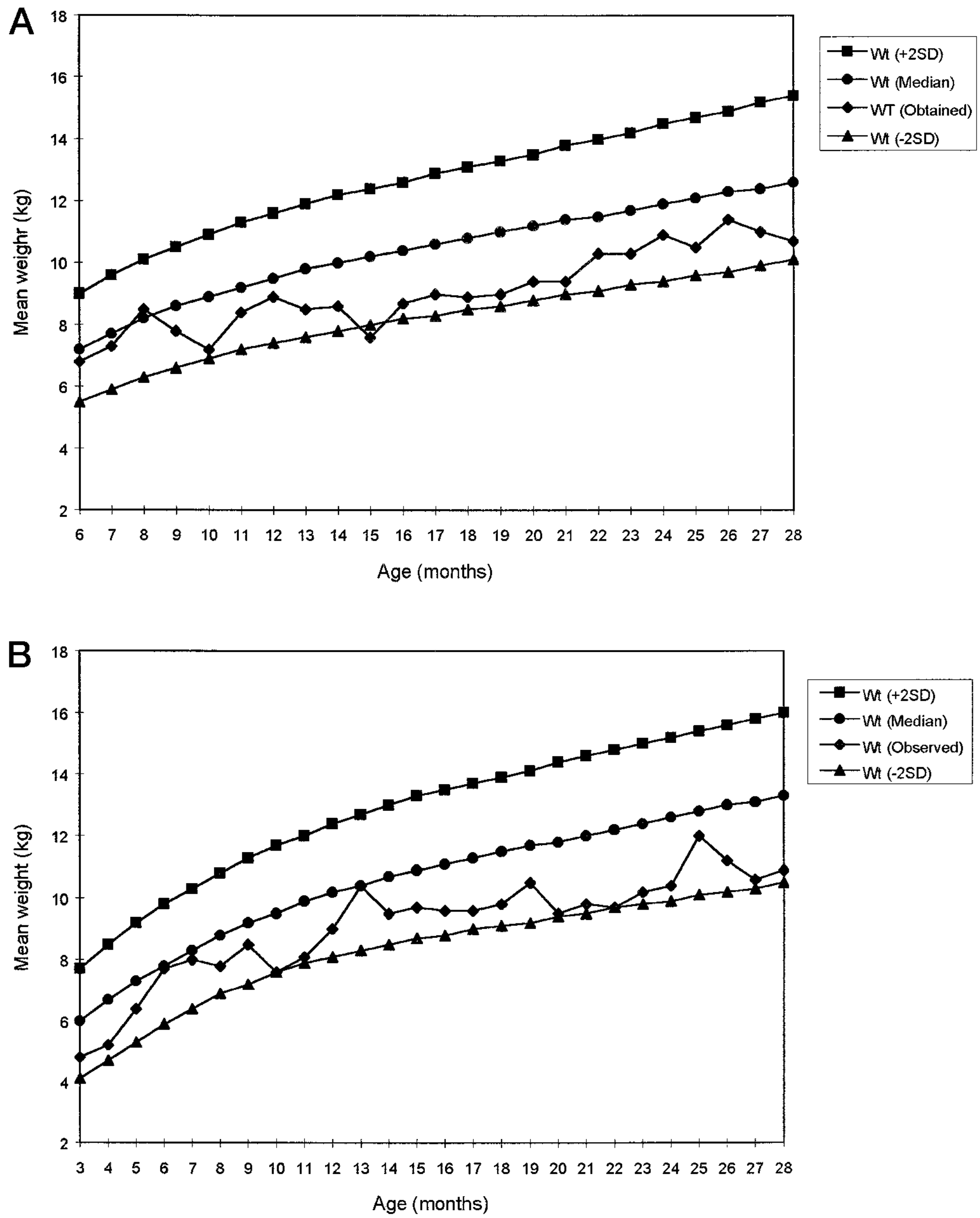


Fig 3. A, Weight-for-age of girls compared with reference. B, Weight-for-age of boys compared with reference.

Factors Influencing Stunting and Underweight

There were sufficient children in the stunted and underweight groups (61 and 62 children, respectively) to allow for extensive cross-examinations with a number of factors by bivariate analysis and the results of this analysis are given below.

Influence of Demographic and Health-related Factors

Older children showed a higher incidence of stunting than younger children ($P \leq .0001$) (Table 1) in both rural ($P \leq .0001$) and urban ($P = .011$) areas. However, age had no effect on the incidence of underweight nor had gender or birth order any influence on the prevalence of stunting or the prevalence of underweight. Poor health status (clinical examination) was important ($P \leq .0001$) in increasing the incidence of both stunted and underweight children (Table 1). Stunted children showed greater ($P \leq .0001$) incidence of underweight and marasmic children showed greater incidence of stunting ($P \leq .0001$) and underweight ($P \leq .0001$). All the children who were marasmic were stunted. Wasted children showed greater ($P = .012$) incidence of underweight and children with low MUAC were significantly more stunted ($P \leq .0001$) and underweight ($P \leq .0001$).

Influence of Weaning Practices and Other Dietary Factors

Neither current breastfeeding nor the age of weaning influenced the incidence of stunting or underweight but the age of termination of breastfeeding or duration of breastfeeding greatly ($P \leq .0001$) influenced stunting; children who were breastfed for prolonged periods (>18 months and up to 24 months) having greater incidence (Table 1) in both rural ($P = .045$) and urban ($P = .003$) areas. Children who had never consumed milk showed a higher incidence ($P = .041$) of underweight (Table 1). Children who

TABLE 1. Distribution of Stunting and Underweight Against Some Child-related Variables (Total $n = 261$)

Variable	Stunting, $n = 62$ % (number)	Underweight, $n = 63$ % (number)
Demographic and health		
Age of child	$P \leq .0001$	$P = .936$
<12 Mo (75)*	6.7 (5)†	22.7 (17)
12–18 Mo (100)	31.0 (31)	25.0 (25)
>18 Mo (86)	30.2 (26)	24.4 (21)
Health of child	$P \leq .0001$	$P \leq .0001$
Healthy (205)	17.1 (35)	14.6 (30)
Unhealthy (56)	48.2 (27)	58.9 (33)
Diarrhea (previous 7 days)	$P = .195$	$P = .227$
Yes (60)	30.0 (18)	30.0 (18)
No (201)	21.9 (44)	22.4 (45)
Feeding practices		
Age removed from the breast ($n = 90$)	$P \leq .0001$	$P = .769$
<12 Mo (9)	22.2 (2)	22.2 (2)
12–18 Mo (18)	11.1 (2)	22.2 (4)
>18 Mo (63)	33.3 (21)	23.8 (15)
Age of onset of supplementary feeding	$P = .129$	$P = .159$
<3 Mo (115)	18.3 (21)	17.4 (20)
4–6 Mo (118)	25.2 (30)	28.0 (33)
>7 Mo (28)	39.3 (11)	35.7 (10)
Milk consumption status	$P = .116$	$P = .041$
Never consumed (28)	35.7 (10)	17.9 (5)
Consumed (233)	22.3 (52)	4.3 (10)
Number of meals/day for child	$P = .502$	$P = .754$
One meal (36)	27.8 (10)	25.0 (9)
Two meals (108)	19.4 (21)	21.3 (23)
Three meals (117)	26.5 (31)	26.5 (31)
Energy density of the food (kcal/100 g dry matter) $n = 126$	$P = .031$	$P = .217$
<350.0 (45)	44.4 (20)	31.1 (14)
350.0–400.0 (50)	24.0 (12)	16.0 (8)
>400.0 (31)	19.4 (6)	22.6 (7)

* Number of children.
† Percent and number of malnourished children per category.

were fed foods of low energy density (kcal/100 g dry matter) had greater ($P = .031$) incidence of stunting but not underweight (Table 1). Food taboos had no influence on either the rate of stunting or underweight.

Influence of Mother and Household/environmental Factors

The age of the mother, occupation, parity, and number of children <5 years of age had no effect on the prevalence of stunting or underweight. Education of the mother had no significant influence on the nutritional status of the children, but when age of the child was controlled for, it showed that better educated mothers had less stunted children ($P = .045$). Indeed, none of the infants (<12 months of age) of mothers who had completed the primary level of education were stunted. Similar positive association between education of the mother and the stunting or general health of the children have been reported from Uganda[8,9,29] and Bangladesh.[30]

Children from rural areas were more underweight ($P = .031$) than those from the urban areas (Table 2). Children from very low economic status families being more stunted ($P = .034$) than those from lower or middle status families (Table 2). Only when area of residence was controlled for, however, did the economic status of the family became significant ($P = .014$) for underweight with urban, but not rural, children from lower socioeconomic status households showing more underweight.

As found by Vella et al[9] in northwestern Uganda, children whose families used water from unprotected sources were more underweight ($P = .045$) than their more fortunate counterparts (Table 2). However, the source of water had no effect on the incidence of stunting. Families who had alternative sources of fuel in addition to firewood, such as charcoal ($P = .028$) and paraffin ($P = .018$), had fewer children underweight than those who had only firewood ($P = .025$) for fuel (Table 2). Urban, but not rural, children whose homes used charcoal as a major source of cooking fuel showed less stunting than those who did not use charcoal ($P = .012$). In addition, urban children whose families used paraffin as a major fuel source had significantly ($P = .018$) less stunting than children from families who did not use it, particularly in urban areas. Children from dirty and very dirty households were more underweight ($P = .037$) than children whose households were clean (Table 2).

Further Analysis of the Risk Factors for Stunting and Underweight by Logistic Regression Analysis

In addition to the bivariate analysis using cross-tabulations, further investigation into the risk factors for malnutrition of children in Uganda was performed using logistic regression analysis. The nutritional status indicators chosen as the dependent variables for this investigation were stunting and underweight. A stepwise logistic regression analysis was performed following the methods of Collett.[15] Several logistic regression models were created and compared using the change in deviance compared with the χ^2 distribution at the 5%

TABLE 2. Distribution of Stunting and Underweight Against Mother- and Household-related Variables (total $n = 261$)

Variable	Stunting, $n = 62$ % (number)	Underweight, $n = 63$ % (number)
Mother-related factors		
Formal education	$P = .885$	$P = .885$
No formal education (17)*	29.4 (5)†	29.4 (5)
Primary (incomplete) (125)	24.0 (30)	23.2 (29)
Primary (completed) (52)	25.0 (13)	26.9 (14)
Secondary and above (67)	20.9 (14)	22.4 (15)
No. of children <5 years	$P = .537$	$P = .880$
1 child (76)	26.3 (20)	22.3 (17)
2 children (138)	21.0 (29)	25.4 (35)
3 children (47)	27.7 (13)	23.4 (11)
Environmental factors		
Area of residence	$P = .881$	$P = .031$
Rural (183)	23.5 (43)	27.9 (51)
Urban (78)	24.4 (19)	15.4 (12)
Economic status of family	$P = .034$	$P = .108$
Mid-upper (38)	7.9 (3)	13.2 (5)
Lower (181)	25.4 (46)	24.3 (44)
Very low (42)	31.0 (13)	33.3 (14)
Source of water	$P = .894$	$P = .45$
Unprotected (137)	24.1 (33)	29.2 (40)
Protected (124)	23.4 (29)	18.6 (23)
Firewood as only source of fuel	$P = .412$	$P = .025$
Only source (196)	25.0 (49)	27.6 (54)
Not only source (65)	20.0 (13)	13.9 (9)
Charcoal as main source of fuel	$P = .372$	$P = .029$
Main source (101)	20.8 (21)	27.6 (54)
Not main source (160)	25.6 (41)	13.9 (9)
Paraffin as main source of fuel	$P = .018$	$P = .018$
Main source (68)	13.2 (9)	14.7 (10)
Not main source (193)	27.5 (53)	27.5 (53)
Cleanliness	$P = .290$	$P = .037$
Clean (33)	15.2 (5)	9.1 (3)
Moderately clean (167)	23.4 (39)	24.0 (40)
Dirty/very dirty (61)	29.5 (18)	32.8 (20)

* Number of children.
† Percent and number of malnourished children per category.

level. The factors that emerged as significant influencers of malnutrition of the children are presented in Table 3. The risk of a child being stunted or underweight relative to the exposure variables identified by the logistic regression model was determined using the odds ratio statistic (Table 3).

The risk of older children being stunted relative to younger children were high: 6 times for those in the 12- to 18-month age range and 10 times for those in the >18-month age range. This is in agreement with other studies undertaken in Uganda.[8,9] The risk of healthy children being stunted or underweight was low relative to unhealthy children. Children who had pathologic problems with their eyes indicative of nutritional deficiencies were at a higher risk of being stunted relative to children with healthy eyes. The risk of stunting was low for children who were breastfed to 18 months compared with those who were breastfed only in early infancy. However, continuation of breastfeeding >18 months up to 24 months increased the risk of stunting almost sevenfold. The same observations have been made by others in The Gambia,[31] in Zambia,[32] in India,[33] and in Uganda,[9] and may be because of insufficient breast milk and underfeeding the child.[34] However, continuation of breastfeeding >24 months decreased the risk of stunting considerably in agreement with previous findings in Zambia,[32] possibly because the child is big enough at that age to consume family food normally. The children who consumed more food per meal had a lower risk of stunting relative to those who consumed small quantities of food.

Children from the urban areas had a lower risk of being underweight relative to children from the rural areas. The children from households with a low or very low socioeconomic status had two and one-half times the risk of being underweight relative to children who came from households with a middle to

TABLE 3. The Regression Coefficients and the Odds Ratios of the Risk Factors for Stunting, Underweight, and Low MUAC (Total $n = 261$)

Stunting			Underweight		
Variable	Regression Coefficient (SE)	Odds Ratio	Variable	Regression Coefficient (SE)	Odds Ratio
Age of child			Health of child		
<12 Mo*	1.00	1.00	Unhealthy*	1.00	1.00
12–18 Mo	1.86 (0.57)	6.42	Healthy	−2.12 (0.36)	0.53
>18 Mo	2.28 (0.65)	9.78			
Health of child			Source of water		
Unhealthy*	1.00	1.00	Unprotected*	1.00	1.00
Healthy	−2.09 (0.44)	0.12	Protected	−0.24 (0.40)	0.79
State of eyes			Cow's milk		
Unhealthy	1.00	1.00	Consumed*	1.00	1.00
Healthy	−1.48 (0.69)	0.23	Never consumed	0.77 (0.48)	2.16
Duration of breastfeeding			Economic status of the family		
<12 Mo*	1.00	1.00	Mid-upper*	1.00	1.00
12–18 Mo	−0.44 (1.36)	0.64	Lower	0.95 (0.68)	2.57
18–24 Mo	1.90 (1.13)	6.69	Low/very low	0.97 (0.73)	2.62
>24 Mo	−2.82 (1.71)	0.06			
Still breastfeeding	0.84 (1.11)	2.30			
Amount of food consumed/meal					
<120 g/meal*	1.00	1.00			
121–200 g/meal	−0.11 (0.57)	0.90			
201–500 g/meal	−1.03 (0.66)	0.36			
No food sample	0.93 (0.73)	2.53			

* Reference category.

upper socioeconomic status. The children whose homes used water from protected sources had a lower risk of underweight relative to children whose homes used water from unprotected sources. This is in agreement with the findings in northwestern Uganda.[9] Children who had never consumed cow's milk had twice the risk of being underweight relative to those who consumed cow's milk regularly.

CONCLUSIONS

In this survey of children <30 months old in rural and semi-urban communities of central Uganda, >20% were found in poor health by clinical examination. Other markers of nutritional status also indicated poor health. Of the group studied, ~25% were stunted and ~25% were underweight. Severe PEM was found in >5% of children. Whereas longer birth spacing was shown to reduce the risk of kwashiorkor, rural living, the use of unprotected water supplies, lack of charcoal as fuel, and lack of milk consumption, increased the risk of marasmus.

Bivariate analysis showed that risk factors for underweight were similar to the risk factors for marasmus. These were rural living, poor health, use of unprotected water supplies, lack of charcoal as fuel, and lack of personal hygiene. Further analysis of the data by logistic regression showed that lack of milk consumption was an additional risk factor.

Bivariate analysis showed that risk factors for stunted growth differed markedly from those for marasmus and underweight. They were older age, poor health (assessed by clinical examination), prolonged breastfeeding, low socioeconomic status of the family, lack of paraffin as fuel, and consumption of food of low energy density. Further analysis of the data by logistic regression showed that the presence of eye pathology and consumption of small meals were additional risk factors. The reason for the differences in risk factors for stunting and underweight are not known.

Although immunization against the major killer diseases of childhood had been achieved in >90% of the children surveyed and the incidence of measles was low, many were recorded as having diarrhea, malaria, or cough/influenza, in the week preceding the survey. This indicates widespread prevalence of poor immunocompetence among the children studied consequent on poor nutrition, a finding that warrants further investigation using methodologies to assess immune function.

ACKNOWLEDGMENTS

The study was supported by funds from the World Bank through the Uganda National Agricultural Research Organization.

We thank Mr Richard Kajura and Mr Richard Basalirwa for technical assistance during the field work. We are also grateful to advice on computer software use and data handling from staff of the Department of Applied Statistics, the University of Reading.

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Joyce K. Kikafunda, Ann F. Walker, David Collett and James K. Tumwine

Pediatrics 1998;102;e45
DOI: 10.1542/peds.102.4.e45