A Survey of Dietary Habits in Children Younger than Four in Informal settlements in Nairobi, Kenya

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Currently 195 million children under five years of age are affected by malnutrition globally; 90% of these children live in South Asia and sub-Saharan Africa. Additionally, malnutrition contributes to more than one-third of all childhood deaths in children under five years of age globally. There is limited data addressing the effect poor nutrition could have on growth and stature of children under five years of age living in informal settlements in Nairobi, Kenya. The purpose of this pilot study is to describe the differences in nutritional habits of children under four years of age living in informal settlements in Nairobi, Kenya, and determine if there is a relationship to their growth and development.

This survey was conducted between April 28 and May 5, 2014, in the Baba Dogo and Korogocho districts of Nairobi, Kenya, which are communities characterized by low-income and minimal resources. All children less than four years old presenting to the medical clinics, organized by Ross University School of Medicine were evaluated. Using a standard procedure, height and head circumference were recorded as well as caregiver's responses to questions regarding feeding practices.

69 children participated in this survey. The majority were male (57%), the median age of the participants was 18 months, the median height was 77cm, and the median age-adjusted height percentile was 10%. 76.6% of females and 74.3% of males were categorized in less than the 50th percentile of height. These children tended to be older, were weaned at an average older age, but were breastfed at about the same age compared to the average age.

Children living in the informal settlements of Baba Dogo and Korogocho districts were more likely to fall below the 50th percentile for height. No conclusions could be made about how protein intake and breastfeeding habits affected height, however the high numbers of children falling below the 50% percentile could suggest that living and environmental conditions as well as malnutrition could play a role in a child's growth and development. Confronting malnutrition in the informal settlements should be a focus of government programs for nutritional assistance and supplementation.

Introduction

Malnutrition is a medical condition characterized by a deficiency of energy, essential proteins, fats, vitamins and minerals in a diet. Malnutrition in low and middle income countries has been and continues to be a major public health problem affecting millions of children worldwide contributing to more than one-third of all deaths in children under age five globally.[1,2] There are currently 195 million children under five years of age affected by malnutrition, of whom 90% live in South Asia and sub-Saharan Africa.[2]

Sub-Saharan Africa has the highest mortality rate for children under five years of age, of 92 deaths per 1,000 live births. Although Sub-Saharan Africa has seen a continuous decline in the mortality rate for children under five years of age, the region still has a mortality rate of 7 deaths per 1,000 live births, more than 15 times the average for high income countries.[3] It is estimated that by 2050, close to 40% of all births globally will take place in sub-Saharan Africa, and 37% of children under five years of age will live in this region. As a result, the observed decrease in deaths in under-five children could stagnate or even increase without more progress in the region.[3]

To address child mortality rates The United Nations World Summit for Children composed of 71 heads of State and Government and 88 other senior delegates met at the United Nations in 1990 and established 27 specific goals related to children's survival, nutrition, health, education, and protection. Additionally, they aimed to decrease child mortality to less than 70 deaths per 1000 livebirths.[3] While this goal was difficult to achieve in the 1990s, the number of children under five years old dying worldwide declined from 12.7 million in 1990 to 6.3 million in 2013, translating to approximately 17,000 fewer children dying each day in 2013 compared to 1990;[3] Nevertheless, thousands of under-five children today, still die daily due to a lack of proper nutrition.

Proper nutrition is essential in the early phases of infant growth and development. To ensure proper nutrition during this time period, infants zero to six months of age should ingest 60g/day of carbohydrates, 9.1g/day of protein and 31g/day of fat as well as a variety of Vitamins including: Vitamin A, B12, C, D, E, K, Folate, Calcium and Iron.[4] Infants 7-12 months old should ingest 95g/day of carbohydrates 11g/day of protein and 30g/day of fat as well as vitamins A, B12, C, D, E, K, Folate, Calcium and Iron.[4] Without these essential dietary components in the first 1000 days of an infant's life, which are characterized by important phases of brain growth and development, various adverse health outcomes can occur.[4,5]

Nutritional requirements are important not only for growth of the brain, but also for stature. When determining nutritional requirements in a child, it is important to determine their net nutrition. Net nutrition is the difference between food intake and losses to both activity and disease——most obviously diarrheal disease, although fevers or respiratory infections also carry a nutritive tax. The most important nutrients in childhood that affect final adult height are protein, calcium and vitamins A and D.[8] Empirical evidence suggests that race and ethnicity do not affect the distribution of healthy height

Table 1. Descriptive Statistics for Children Less than Four Classified as in the Greater than or Equal to the 50th Height Percentile and Less than the 50th Percentile in Baba Dogo and Korogocho Clinics, Nairobi, Kenya 28 April 2014 to 5 May 2014

	Median(IQR)		Mean(SE)		
	≥ 50%	<50%	≥ 50%	<50%	*P* value*
Female†	7(41)	23(44)			1.000
Male†	10(59)	29(56)			
Age‡	12(11)	19(19)	16(3.36)	20(1.65)	.1567
Breast Fed†	6(35)	13(25)			.6086
Age of weaning breast milk‡	6(0.75)	6(0)	5.9(.67)	6.2(0.25)	.6114
Age Fully Stopped Breast Feeding‡	18(15.75)	19(12)	20.3(6.17)	19.3(1.48)	.9174
Receives protein (Yes/No) †	7(41)	16(31)			.6214

*-Chi-square test for categorical variables and Wilcoxon Two-sample (Mann-Whitney U) Test for continuous variables
†-Frequency and percentage
‡-months

for the first five years of life, and any variation between populations or ethnic groups below five years of age could result from various factors other than genetic predisposition.[6–8] Consequently, adult height has been interpreted by some studies to be an indicator of both economics of and the amount of disease present in the child's environment.[9] Early linear growth retardation can lead to reduced economic productivity in adulthood, unfavorable maternal reproductive outcomes and increased risk of development of non-communicable diseases.[10,11]

Stunted growth is largely multifactorial and influenced by the context in which a child is born.[12] Stewart et al mentioned that stunted growth and development are manifestations of malnutrition with long and short-term consequences and are attributable to a combination of household and family factors, inadequate complementary feeding, inadequate breastfeeding practices, and infection.[12,13] Complementary feeding for infants refers to the timely introduction of safe and nutritionally rich foods in addition to breast-feeding at about six months of age and is typically provided from six to 23 months of age.[14] Stunted growth is also a result of the political economy, the health and health care system, education, society and culture, agriculture and food systems, water and sanitation and the environment.[5]

Growth differences can also vary as a function of gender.[15] At birth, the skeletal maturation of females is four to six weeks more advanced than that of males—this discrepancy continues throughout childhood and adolescence.[15] Female growth velocity is slightly slower in birth compared to males, becoming equal to that of males at around seven months of age. From seven months of age to four years, female growth velocity becomes slightly faster than that of males.[15] At four years of age, children of both sexes grow at approximately the same rate until the adolescent growth spurt.[16,17] Black infants tend to be smaller at birth but experience an acceleration of linear growth resulting in a greater height than white children during the first few years of life.[15]

There is limited research regarding infant and childhood growth rates and whether there is a difference in these rates between males and females living in informal settlements of Kenya. It has been recognized that nationally, Kenya houses 35% of under-five children who are stunted, 16% who are underweight and 7% who are wasted.18 The prevalence of malnutrition is particularly high in urban slums, or informal settlements, where stunting rates among children under five years old is greater than 40%.[19]

Informal settlements are defined by the UN Habitat Programme as residential areas where a group of housing units have been constructed on land to which occupants have no legal claim, or which they occupy illegally. Frequently, informal settlements can be tremendously overcrowded with substandard housing, unclean and insufficient quantities of water and inadequate sanitation. More than 60% of Nairobi residents live in informal settlements where poverty combined with infections, food insecurity, poor maternal nutrition and poor child feeding practices are readily apparent.[20] Thus this pilot study aims to describe differences in demographic and nutritional factors of children under five years of age living in informal settlements in Nairobi, Kenya and determine if there is a relationship to their growth and development.

Method

The survey was conducted in the informal settlements of Baba Dogo and Korogocho districts of Nairobi, Kenya between April 28 and May 5, 2014. Low-income residents with minimal resources characterize these sections of Nairobi. All children less than four years old seen at the Baba Dogo and Korogocho clinics were evaluated regardless of reason for visit. A one-hour training session to standardize methods of measuring height and head circumference was held. Using a standard tape measure, MABIS, height and head circumference were recorded to the nearest inch and then plotted on either the WHO or CDC height for age growth chart. Head circumference was measured in addition to height for age to more thoroughly assess malnutrition, and because both are commonly used to assess malnutrition. The WHO height for age growth chart was used for male and female infants and children zero to two years of age. The CDC height for age growth chart was used for male and female children two years of age and older. Additionally, a list of questions regarding feeding practices, which were to be asked of all participants' caregivers, was distributed to medical students assisting with the project. Written consent for the project was obtained from our local NGO collaborator. Each parent gave verbal consent. The Ross University School of Medicine IRB approved the investigation, and it was conducted in accordance with the Belmont Report and the tenets put forth in the Declaration of Helsinki. The Belmont Report identifies basic ethical principles that should underlie biomedical and behavioral research involving human subjects and provides guidelines, which assures that research is conducted in accordance with those principles.[21] The Declaration of Helsinki is a set of ethical principles regarding human experimentation developed for the medical community by the World Medical Association and is regarded as the cornerstone document on human research ethics.[22]

Independent Variable

There are five independent variables for this investigation: age (months), whether the child was breastfed, age at weaning of breast milk (months), age fully stopped breast-feeding (months), whether the child received protein from their daily diet and if so, how often. Using weaning of breast milk as a variable could present a problem in the accuracy of results because weaning periods vary between individuals and could take place over a short period of less than one month or over several months. The ratio of solid foods to breast milk could vary widely among the study population.

Dependent Variable

The dependent variable for the investigation was growth percentile. Measurements were taken of all children presenting to the clinics. Growth chart percentile was calculated using WHO or CDC height for age growth percentile charts.23 Percentile was categorized as less than 50th percentile (coded as 1) or equal to or greater than 50th percentile (coded as 0).

Analysis

Descriptive statistics (median, interquartile range, mean, standard error for quantitative variables, and frequency and percentage for qualitative variables) were calculated for all independent variables. Two-sample Wilcoxon rank sum tests were used to test for significant differences

Table 2. Frequency Distribution of Proteins Eaten for Children Less than Four Classified as in the Greater than or Equal to the 50th Height Percentile and Less than the 50th Percentile in Baba Dogo and Korogocho Clinics, Nairobi, Kenya April 28, 2014 to May 5, 2014

Protein Eaten	≥50%	<50%
Three Times a Day	0(0)	4(100)
Twice a Day	0(0)	6(100)
Once a Day	7(50)	7(50)
Rare Intake	0(0)	1(100)
Mainly Breast Milk	6(32)	13 (68)
No Daily Intake	2(40)	3(60)
Unknown	2(10)	18(90)

for each continuous independent variable between height percentile less than 50 percent and height percentile equal to or greater than 50 percent. Chi-square tests were used to test for significant differences in categorical independent variables between height percentile less than 50 percent and height percentile equal to or greater than 50 percent. An a priori alpha level of .05 was used to test for significant differences.

When examining relationships of continuous variables and assessing prediction, linear regression is the preferred methodology.[24] Partial F testing was used to test if variables were significant predictors of height in centimeters using an a priori alpha level of .[20] for model selection.[24] Significant predictors and interaction terms were entered into linear regression models. Height in centimeters was modeled in a linear fashion, and height percentile was modeled as a logit transformation of percentile.[25–27]

Results

There were a total of 69 children participating in this investigation. The majority of participants were male (n=39; 57%); the median age of participants was 18 months (IQR: 20 months); the median height was 77cm (IQR: 13cm); and the median age-adjusted height percentile was 10% (IQR: 47%). Participants were divided into those equal to or greater than the 50th percentile and those less than the 50th percentile (n=52; 75%) on the WHO and CDC height-for-age growth chart.

Descriptive statistics for the cohort can be seen in Table 1. The majority for males and for females were categorized as less than the 50th percentile of height. Those children in the less than 50th percentile group tended to be older, weaned at an average older age (although at the same median age), but stopped breast-feeding at about the same age. There were no significant differences between the groups. No statistically significant differences were detected between the independent variables for those in the 50th percentile or greater in height versus those in the less than 50th percentile.

The frequency of protein intake can be seen in Table 2. Ten participants consumed protein more than once a day, for three times daily and six twice daily, all falling in the less than 50th percentile group. Seven participants in each group consumed protein once a day. More children in the less than 50th percentile tended to have a rare intake of protein (less than seven times a week), have a diet consisting of mainly breast milk and have unidentified protein consumption. Children with no daily protein intake appeared to be equally divided.

A linear regression model was constructed to predict the height of participants based on the age at which each participant was weaned (months), the age at which each participant stopped breast-feeding (months), whether the participant received protein (reference: no), whether the participant was female (reference: male), the age of the participant (months), and a gender-age interaction term. Partial F testing was conducted and the following variables were not found to contribute significantly to the prediction of height in centimeters: age participant was weaned (months), age participant stopped breastfeeding (months), and whether the participant received protein (reference: no). Gender (reference: male) and age in months were significant predictors of height in centimeters. Another model was constructed using the same variables (age, gender and gender-age interaction) for a logit transformed model of height percentile. Results for both models can be seen in Table 3. All analyses were done using R software.[29]

Discussion

75% of children less than four years of age living in the informal settlements of Baba Dogo and Korogocho, Nairobi, Kenya, were found to be less than 50% on the WHO and CDC growth curve, height-for-age, supporting our hypothesis. 23 of 30 females (77%) and 29 of 39 (74%) males were in the less than 50th percentile for height-for-age. We know stature is part of a multi-factorial process including political atmosphere, water and sanitation, food and agriculture and education.[5] We were able to determine that more children in the less than 50% group had rare or unknown daily protein intake. This measurement was determined by our questionnaire leading to a subjective answer. Food security questions such as the availability and access to food, as well as availability and access to clean water were not addressed.

Those in the less than 50th percentile were weaned from the breast at an older age, but stopped breast-feeding at approximately the same age as those in the more than 50th percentile group. With the design of our study we were unable to demonstrate a link between malnutrition, little protein intake, and inappropriate breastfeeding and short stature. The only statistically significant predictors of height in our sample were age and age-for-gender interaction.

A similar study performed in an informal settlement community of Kibera, Kenya showed a majority of caregivers were experiencing a food shortage at the time of the survey. The study found the prevalence of stunting overall in children six to 59 months was 47% and increased to 58% in children aged 36 to 47 months with a similar distribution between genders: males having 51% and females having 49%.[18] During this time in the children's lives, they begin to feed themselves and eat their family's diet. As such, they become more susceptible to poor nutrition with decreased availability of solid food, protein and energy intake and poor weaning practices.[30]

Numerous other studies suggest that children in Kenya have short stature – a possible indicator of poor nutrition.[30] A study performed in another informal setting of Dagoretti, Nairobi, Kenya, showed that 25% of the children surveyed were stunted, 15% were underweight and 10% experienced wasting, which refers to inadequate nutrition over a shorter period of time. This study also found that there were more boys than girls who were stunted, similar to our findings. Additionally, the researchers found that breakfast contributed to 10% of the daily energy intake of children (adequate is 20-30%) and fewer children consumed foods from greater than four food groups.[31] Finally, it was shown that the incidence of diarrhea, colds and coughs increased the risk of stunting and being underweight.[31]

Another study performed in Uasin Gishu County, one of the 47 counties in Kenya, compared nutritional status of orphaned and separated children and adolescents living in households with extended family, children's charitable institutions, and on the streets found that 74% of study participants were stunted according to WHO standards.[32] This is in agreement with our findings of roughly 75% participants being less than the 50th percentile of height-for-age. Interestingly, the Uasin Gishu County study found those living in households with extended family to be two to three times more likely to be stunted than those in children's institutions.[32] Additionally the researchers determined that street youth were six times more likely to be stunted compared to the children living in children's institutions.[32] This study suggests that the children living in households with extended family or on the street were chronically under- or malnourished.[32] A potential reason why this study could be valid is because children living in households with an extended family with multiple people, could be consuming the left-over food instead of receiving an adequate portion. Additionally, kids living on the street are usually scrambling for food and will eat whatever they can find. Both of these situations could lead to under or malnutrition.

In a rural Uganda study, results showed that socioeconomic indicators, namely a mother's education, correlates with the inequalities in children's health and nutrition using growth stunting as the proxy for the inequalities. A mother's education was found to be a robust predictor for inequalities of child health and nutrition.[8] Another study performed throughout five countries in sub-Saharan Africa highlighted the need for education of parents and healthcare professionals in order to increase their knowledge of breast-feeding, vaccination programs and over- and under-nutrition.[33]

Table 3. Beta coefficients, standard errors, *P* values, and 95% confidence intervals for a linear regression model predicting height in centimeters and logit transformation of height percentile

	Linear Model				Logit Transformed Percentile			
Independent Variable	**β**	**SE(β)**	***P* value**	**95%CI**	**β**	**SE(β)**	***P* value**	**95%CI**
Intercept	58.19	1.58	<.0001	(55.04, 61.34)	-2.67	0.81	.0015	(-4.29, -1.06)
Female	1.42	2.39	.5543	(-3.36, 6.20)	1.85	1.23	.1353	(-0.59, 4.30)
Age	1.04	0.07	<.0001	(0.89, 1.19)	0.04	0.04	.2970	(-0.04, 0.12)
Female x Age	-0.27	0.10	.0103	(-0.48, -0.07)	-0.11	0.05	.0440	(-0.22, -0.01)
Adjusted R^2			0.8199				0.0252	

Conclusion

Undernutrition and malnutrition are major problems in the informal settlements of Baba Dogo and Korogocho districts of Nairobi, Kenya. 52 of the 69 participants in our study were classified as being in the less than 50th percentile for height based on the WHO and CDC growth chart for height-for-age which is suggestive of chronic malnutrition. These children were weaned from the breast at an older age and were classified as having rare protein intake. These findings could imply that these children are not being supplemented or fed proper nutrition. Unfortunately, we were unable to examine any relationship between protein intake and breastfeeding habits and short stature perhaps due to some of the limitations we faced.

The main limitation in our study was the relatively small sample size. The population was limited to those children who visited the clinics organized by the Ross University School of Medicine, since the medical students did not actively seek out participants. As such, this population could be biased since the children in our sample were actively seeking out medical care. The study could have been improved by actively seeking well children in the community and increasing the sample size. Similarly, with this possible predisposition to acute and chronic illness in our sample chief complaint, diagnosis, HIV status and mean parental height were not recorded during their clinic visit. Chronicling data of this sort would allow us to improve on cause or predisposition to short stature. To more accurately diagnose acute and chronic malnutrition, weight of each participant could have been measured to look at weight-for-age and weight-for-height. Additionally, the young age of participants in the study was a limitation. The young age of the participants limits the generalizability of the study. Further, by only examining the first few years of life this study could not obtain a complete picture of early childhood nutrition.

To adequately determine the prevalence of early childhood malnutrition, future investigators could conduct studies comparing children who live in informal settlements to children who live in an urban apartment/single family home. Questions regarding protein, fat and carbohydrate intake as well as the intake of daily vitamins could be addressed. Furthermore, the investigators could follow these two groups of children into adolescence, measuring their growth at various stages of development and compare their stature and nutritional habits. Additionally, future investigators could record the parental height of children living in informal settlements to those living in an urban apartment/single family home which may give some insight on the role nutrition versus genetics plays in linear development.

Future studies could also compare stature in breast fed infants to non-breastfed infants living in both informal settlements compared to an urban apartment/single family home to determine if breast milk has a role on linear childhood growth. This would be a fascinating study, since the majority of children included in this study were exclusively breastfed.

Key Messages

Future research in this discipline should focus on the difference between children under four living in the informal settlements of Baba Dogo and Korogocho and children under four living in an urban apartment/single family home. This could allow future investigators to determine if factors such as food insecurity, poverty, maternal malnutrition, overcrowding, poor access and availability to water and sanitation have an effect on growth and development.

Nutritional programs and supplementation in the informal settlements of Baba Dogo and Korogocho should be a focus of aid groups working in Eastern Africa, specifically Kenya, to confront this chronic issue of malnutrition. In an effort to address the burden of malnutrition, Kenya signed up to the Scaling up Nutrition (SUN) Movement in 2012, which combines governments, civil society, private sector, researchers, United Nations and donors to implement both nutrition-specific and nutrition-sensitive interventions and strategies to address malnutrition. Furthermore, Kenya has developed a national nutrition action plan for 2012 to 2017 that lists 11 strategic objectives combating malnutrition and over nutrition. These include improving the nutritional status of children under five years, which entails increasing exclusive breastfeeding practices, timely introduction of complementary feeding and micronutrient supplementation.

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