



Original Article

Foot Length as a Predictor of Weight in Children up to Five Years

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Abstract

Weight measurement is essential for the management of pediatric patients to calculate the dose of the drugs. But it is not possible to move the child to a weighing scale for determination of body weight when the child is in a critical condition. The purpose of this study was to check if foot length correlates with child's body weight in our situation and to devise a formula for prediction of weight based on foot-length observed. This Cross-sectional study was carried out in the Department of Pediatrics, Sir Salimullah Medical College, Mitford hospital, Dhaka over a period of 12 months between January 2008 and December 2008. A total of 300 children, between 0 day to five years, meeting the predefined eligibility criteria were included in the study. Using the available data, simple linear regression analysis was performed between the dependent variable weight and independent variable foot length. The estimated linear regression line was: Predicted weight (kg) = a+ [b× foot length]. Data were analyzed using correlation coefficient (r) between foot length and children's weight. In this study correlation between foot length and weight (r) was 0.92(P<0.001) indicating a perfect linear relationship between them. In the present study determination of correlation (r^2) was 0.85 meaning that 85% of the variability in weight might be explained by variation in foot length. The estimated linear regression line was: Predicted weight (kg) = - 4.64 + [1.12 X foot length], where- 4.64 was the intercept and 1.12 was the slope of the regression line. Comparison between measured weight and predicted weight revealed that 94% of variation between measured weight and predicted weight was within ± 2 kg. More than half of the cases (58.3%) the above-mentioned variations were within ± 1 kg.

This study concluded, there was a strong correlation between foot length and weight in children up to five years. The body weight in children from 0 days up to the age of 5 years can be predicted from foot length. Prediction of weight simply by foot-length measurement could be a great help to the health care provider including doctors and health workers for drug dose calculation in critically ill children.

Keywords: Foot length, prediction of weight.

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Introduction

Weight measurement is essential for the management of pediatric patients. Drug dosage in pediatric patient is calculated depending on weight of the child. But it is not possible to move the

child to a weighing scale for determination of body weight when a child presents in a critical condition. Critically ill child gets surrounded by doctors and nurses who immediately begin procedures such as quick clinical evaluation, securing intravenous access, administration of

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oxygen and at times undertaking cardiopulmonary resuscitation. Difficulty is also faced by the health workers at field level to measure weight due to non-availability of costly weighing scale. To treat a child, they have to estimate a wide range of drug dosage based on chronological age, which may not be specific and appropriate for a particular child. Similarly, their practice of drug dosage calculation from adult dose may not be appropriate or safe for a particular child.

A simple, handy, safe and less costly method for the measurement of weight is an immense need. Foot-length measurement could be the right answer in that situation. Previous studies done abroad in the neonates and young children showed that foot length can be used to predict weight, length and nasotracheal tube length.¹⁻⁸ Measuring foot-length is possible even when a child is in critical state. Again foot-length measurement might be regarded as a simple, easy, quick, practical method to predict weight without using weighing scale by the health worker at the field level.

Studies done abroad to predict weight based on foot length mostly included neonates¹⁻⁸ and in one study children up to two years of age were included.¹ In developing countries, children do not visit their doctors regularly; their recent weight record (Pre-illness weight) is often not available. Most parents do not keep the medical records diligently. So, the records of pre-morbid weight are not available. Faced with such situation, prediction of weight simply by foot-length measurement could be of great help to the health care provider including doctors and health workers. The purpose of the present study was, therefore, to check if foot length correlates with child's body weight in our situation and to devise a formula for prediction of weight based on foot-length. Thus, the present study was intended to determine the correlation between foot – length and weight in children from 0 days up to five years, to predict weight using simple foot-length measurement and to compare the predicted weight with the measured weight.

Materials and Methods

This Cross-sectional study was carried out in the Department of Pediatrics, Sir Salimullah Medical College, Mitford hospital, Dhaka over a period of 12 months between January 2008 and December 2008. A total of 300 children between 0 day to five years who met the predefined eligibility criteria were included in the study. Bare foot length in cm was measured using Vernier scale. The children were then weighted using NNC (National Nutrition Council) bar scale. Using the available data, simple linear regression analysis was performed between the dependent variable weight and independent variable foot length. The estimated linear regression line was: Predicted weight (kg) = a+ [b× foot length]. Data were analyzed using correlation coefficient (r) between foot length and children's weight.

Results

300 children between 0 day to 5 years of age were enrolled in this cross sectional study. Table I showed the base line characteristics of the study population. Studied children were divided in different age group. More than 60% of the studied population was below 2 years of age. Among 67 newborn, number of preterm LBW were 44 and the rest 23 were normal term newborn.

Table I: Baseline characteristics of the study population (n=300)

Age (in month)	Number	Percentage
0 - 1	67	22.3
1 - 12	65	21.7
12 - 24	58	19.3
24 - 36	17	5.7
36- 48	50	16.7
48 - 60	43	14.3

Table II showed- among 300 studied children 64.7% were male and 35.3% were female.

Table II: Study population according to sex (n=300)

Sex	Number	Percentage
Male	194	64.7
Female	106	35.3
Total	300	100

Statistical analysis of the relation between foot-length and measured weight was done. The correlation between foot length and measured weight (r) was 0.92, ($P < 0.001$) which indicate strong relationship between the two variables. The determination of correlation (r^2) was 0.85. This indicates that 85% of the variability in weight might be explained by variation in foot length. 85% of the variability in weight might be explained by the liner regression model. Using the available data, simple linear regression analysis was performed between the dependent variable measured weight (kg) and independent variable foot length (cm). The estimated linear regression line is given below:

Predicted weight (kg) = $-4.64 + 1.12 \times \text{foot length}$

where 4.64 was the intercept and 1.12 was the slope of the regression line. The slope value 1.12 indicated that 1 unit change of foot length could change predicted weight 1.12 times.

This study found statistically significant linear relationship between foot length and measured weight ($r = 0.92$, $p < 0.001$). Most of the measured weight values were within 95% confidence limits of predicted weight. The regression line best fitted the present data.

Measured weight was estimated using BNNC bar scale and predicted weight was estimated by using simple linear regression formula. The maximum difference between measured weight and predicted weight lies between -2.44 and +2.87kg. Mean difference between measured weight and predicted weight was -0.19 ± 1.12 kg. Table III showed that in 94% cases the variation between measured weight and predicted weight in studied population was within ± 2 kg. More than half of the cases (58.3%), the above-mentioned variations were within ± 1 kg.

Table III: Pattern of variation between measured weight and predicted weight in studied population (n=300)

Variation between measured weight and predicted weight (kg)	Number	Percentage
0 to 1	70	23.3
1 to 2	29	9.7
2 to 2.87	12	4
-1 to 0	105	35
-1 to -2	78	26
-2 to -2.44	6	2
Total	300	100

Table IV showed mean of variation between measured weight and predicted weight in different age group is the lowest in 48-60 month age group and highest in the 0-1 month age group.

Table IV: Mean of variation between measured weight and predicted weight in different age group of studied population (n=300)

Age group (in month)	Mean of variation (Kg.)
0 - 1	-0.96
1 - 12	0.32
12 - 24	-0.33
24 - 36	0.9
36 - 48	0.49
48 - 60	0.16

Table V showed the variation between measured weight and predicted weight in 0-1-month age group, in half of the cases were within -1 to 0 kg (47.8%) and with in -1 to -2 kg in other half of the cases (52.2%). In 1 to 12-month age group, the above-mentioned variation in 36.9% cases was within 0 to 1 kg and in 27.7% cases were within -1 to 0 kg. In 12 to 24 months age group, the above-mentioned variation in 36.2% cases was within 0 to 1 kg and in 46.6% cases were within -1 to 0 kg. In 24 to 36 months age group, the variation in half of the cases (47%) was within -1 to 0 kg. In 36 to 48 months age group, the variation in half of the cases (52%) was within 0 to -2 kg. In 48 to 60 months age group, the above-mentioned variation in more than one third of the cases (37.2%) was within 0 to 1 kg.

Table V: Pattern of variation between measured weight and predicted weight in different age group of studied population (n=300)

Different age group (month)	Variation 0 to 1 (kg)		Variation 1 to 2 (kg)		Variation 2 to 2.87 (kg)		Variation -1 to 0 (kg)		Variation -1 to -2 (kg)		Variation -2to -2.44 (kg)		Total studied population	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
0 - 1	0	(0)	0	(0)	0	(0)	32	(47.8)	35	(52.2)	0	(0)	67	(100)
1 - 12	24	(36.9)	7	(10.8)	4	(6.2)	18	(27.7)	12	(18.5)	0	(0)	65	(100)
12 - 24	21	(36.2)	2	(3.45)	0	(0)	27	(46.6)	8	(13.8)	0	(0)	58	(100)
24 - 36	1	(5.9)	4	(23.5)	0	(0)	8	(47)	4	(23.5)	0	(0)	17	(100)
36- 48	7	(14)	9	(18.0)	8	(16)	13	(26)	13	(26)	0	(0)	50	(100)
48 - 60	16	(37.2)	7	(16.3)	0	(0)	7	(16.3)	6	(14)	6	(14)	43	(100)

Table VI showed least variations between measured weight and predicted weight (± 1 kg) in different age group of studied population. The above mentioned least variation (± 1 kg) was found in 83% cases in 24-36 month age group and it was in between 40% to 65% of cases in other age groups.

Table VI: Least variation between measured weight and predicted weight (± 1 kg) in different age group of studied population (n=174)

Different age group (month)	Variation 0 to 1 (kg)		Variation -1 to 0 (kg)		Total population		Total least variation (± 1 kg)	
	n	(%)	n	(%)	n	(%)	n	(%)
0 - 1	0		32		67	(100)	32	(48)
1 - 12	24		18		65	(100)	42	(65)
12 - 24	21		27		58	(100)	48	(83)
24 - 36	1		8		17	(100)	9	(53)
36- 48	7		13		50	(100)	20	(40)
48 - 60	16		7		43	(100)	23	(54)
Total	69		105		300	(100)	174	(58)

Discussion

Predicting weight on the basis of chronological age is fraught due to the presence of rampant moderate to severe malnutrition in our community. Weighing a child is often difficult while they are being admitted in hospital in a critical condition. At the field level carrying a weighing machine by a health worker is also difficult. Foot length can be easily measured using a Vernier scale, which is neither costly nor technically challenging to use.

Children up to five years of age constituted bulk of the admissions to the pediatric unit as the emergency cases in this country. This study demonstrated strong correlation (r) between foot length and weight in children up to the age of five

years ($r = 0.92$ $P < 0.001$). Bavdekar et al.¹ found similar correlation (r) between foot length and weight in children up to the age of two years ($r = 0.88$). James et al.² In their study on neonates of gestational age 26-48 weeks, found a positive linear correlation between foot length and birth weight ranging from 0.89 to 0.91 in all gestational ages. In the previous study the strong correlation between foot length and weight was existed in the children up to the age of 2 years but the present study indicated that this strong correlation also extended to children up to the age of 5 years. In this study the correlation (r^2) between foot-length and body weight was 0.85 indicating that 85% of the variation in weight might be explained by the

foot length which compares well with findings of Bavdekar et al.¹ ($r^2 = 0.88$).

In the present study a linear regression equation was developed from the available data to predict weight using simple foot-length measurement. Predicted weight (kg) = - 4.64 + [1.12 X foot length] where -4.64 is the intercept and 1.12 is the slope of the regression line. According to study done by Bavdekar et al.¹ predicted weight (kg) = - 5.15 + [1.35 X foot length] where -5.15 is the intercept and 1.35 is the slope of the regression line. It should be realized that there are population variation in anthropometric dimensions, which are influenced by genetics and environmental factors. So the regression equations generated in these studies may vary in different population. However, the equation generated in the present study might be very useful in predicting weight in our community only.

In this study measured weight was compared with predicted weight which showed that 94% of variations between measured weight and predicted weight in studied population was within ± 2 kg. More than half of the cases (58.3%) in the studied population the above-mentioned variations were within ± 1 kg. The least variation (0 ± 1 kg) between measured weight and predicted weight was found in 83% cases in 24-36-month age group and it was in between 40 to 65% of cases in other age groups. So, using this formula one can predict weight that would be very close to the measured weight in children from 0 days up to the age of 5 years.

Conclusion

This study concluded, there was a strong correlation between foot length and weight in children up to five years. The body weight in children from 0 days up to the age of 5 years can be predicted from foot length. Prediction of weight simply by foot-length measurement could be a great help to the health care provider including doctors and health workers for drug dose calculation in critically ill children.

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