Length estimation based on clinical and anthropometric measures in newborns.

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Background

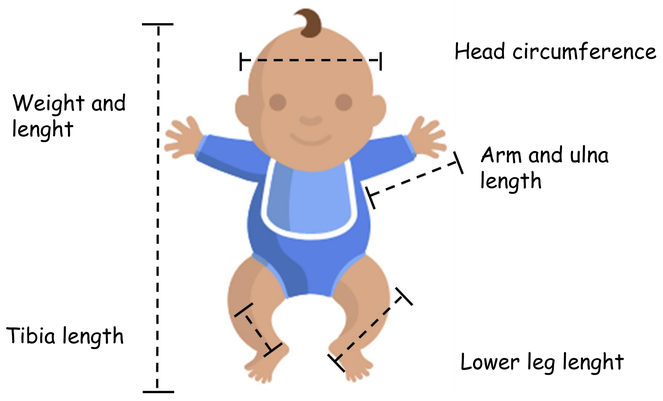
- Nutritional assessment is a fundamental part of the inpatient care of newborns due to the accelerated growth rate at that age (**4.6-6.6 cm** on the first month).
- Invasive procedures in neonatal care units prevent correct measurement.
- As an alternative, anthropometric estimations are used by means of formulas that use the measurement of body segments.
- Their application in neonates is not exact and accurate.

Aim

Identify clinical and anthropometric variables that explain the variability of length in newborns.

Methods

Cross-sectional study. 46 newborns of both sexes were included. Participants were recruited from public and private hospitals in Mexico City.



Results

Standard deviations (SDs) of repeat measurements in newborns.

	SD of differences	Individual SD	Individual SD (% of mean)
Intraobserver variability	(n=18)		
Weight	0.08	0.06	0.13
Length	0.23	0.16	0.11
Head circumference	0.18	0.14	0.11
Arm span	0.57	0.41	0.27
Ulna length	0.13	0.09	0.41
Tibia length	0.17	0.11	0.32
Lower leg length	0.10	0.07	0.14
Interobserver variability	(n=15)		
Weight	0.09	0.07	0.11
Length	0.26	0.19	0.12
Head circumference	0.25	0.18	0.13
Arm span	0.50	0.35	0.22
Ulna length	0.21	0.15	0.61
Tibia length	0.23	0.24	0.65
Lower leg length	0.17	0.12	0.25

General characteristics and correlations with length

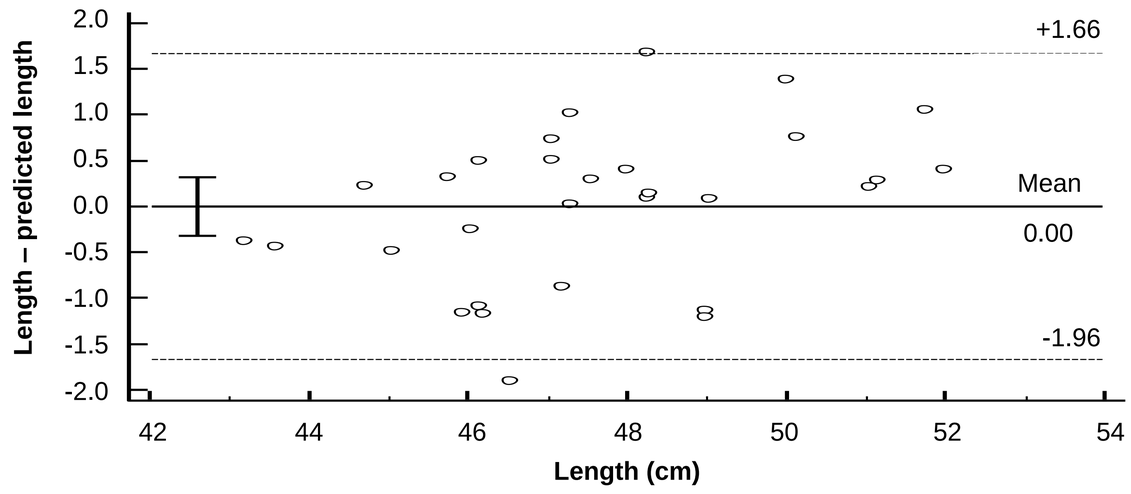
	Mean (SD)	Correlation with length
n Females n (%)	46 25 (54.3)	
Age (days)	6.3 (2.4)	0.27
Gestational age	37.6 (2.1)	0.72*
Birth weight (kg)	2.7 (0.6)	0.76*
Birth length (cm)	47.7 (2.2)	0.46*
Weight (kg)	2.6 (0.5)	0.87**
Length (cm)	47.6 (2.2)	
Head circumference(cm)	33.2 (1.5)	0.78**
Arm span (cm)	7.9 (0.5)	0.68**
Ulna length (cm)	7.2 (1.5)	0.27
Lower leg length (cm)	12.3 (0.9)	0.82**
Tibia length (cm)	8.1 (0.6)	0.44*
Mother's height (cm)	156.2 (5.6)	0.39*
Father's height (cm)	167.8 (8.7)	0.46*

*p<0.05, **p<0.01

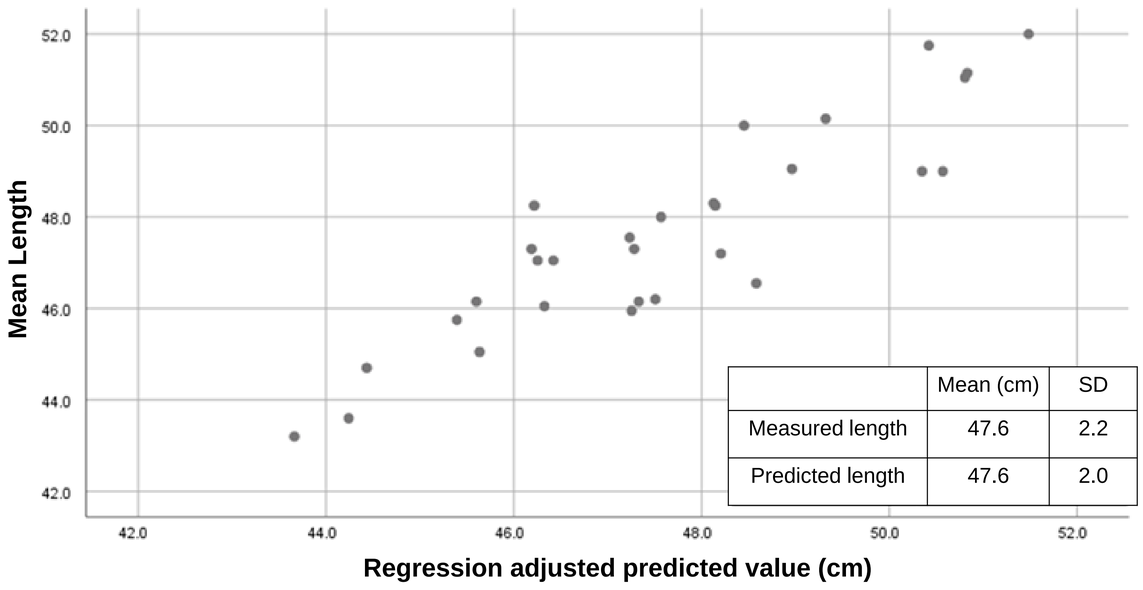
Prediction equations for length estimation.

Prediction equation	r	R^2	SE (cm)	Sig.
1. Weight: $Length(cm) = 36.072 + (4.452 * \text{weight } kg)$	0.88	0.77	1.06	0.0001
2. Weight, lower leg length: $\text{Length } (cm) = 27.272 + (3.307 * weight\ kg) + (0.950 * \text{lower leg length } cm)$	0.92	0.84	0.89	0.0001
3. Lower leg length, sex (1F/2M), head circumference: $\text{Length } (cm) = 4.148 + (0.552 * sex) + (0.747 * head\ circumference\ cm) + (1.448 * \text{lower leg length } cm)$	0.93	0.86	0.89	0.0001

Bland-Altman plot of the difference between predicted and measured length in term and preterm neonates and using the model 3 equation. Reference lines represent the 95% limits of agreement.



Discussion



	Mean (cm)	SD
Measured length	47.6	2.2
Predicted length	47.6	2.0

Comparison of prediction equations

Prediction equations	Mean difference (predicted length-measured length)
Proposal L=4.1477+(1.4478∗LL)+(0.7471∗HC)+(0.5517∗sex)	p=0.998
Stevenson AS L=21.8+(4.35∗AS)	*
Stevenson TL L=30.8+(3.26∗TL)	*
Stevenson LL L=24.2+(2.69∗LL)	*
Gauld AS Males: L=16.258+(0.829∗AS)+(0.721∗A) Females: L=36.976+(0.619∗AS)+(1.593∗A)	* *
Gauld UL Males: L=28.003+(4.605∗UL)+(1.308∗A) Females: L=31.485+(4.459∗UL)+(1.315∗A)	* *
Gauld TL Males: L=36.509+(2.758∗TL)+(1.717∗A) Females: L=37.748+(2.771∗TL)+(1.457∗A)	* *
Gauld LL Males: L=21.818+(2.423∗LL)+(1.327∗A) Females: L=21.151+(2.473∗LL)+(1.187∗A)	* *

L, length; HC, head circumference; LL, lower leg length; AS, arm span; TL, tibia length; UL, ulna length; A, age.

cm -25 -20 -15 -10 -5 0 5 10 15 20 25

Conclusions

Our linear regression model is more accurate to estimate the Crown-heel length of newborns tan previously reported methods. This formula could be a great tool to assess the nutritional status of hospitalized newborns in whom it is not possible to measure the length with the gold standard.

References

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