Intra- and inter-rater reliability of estimated dimensions of anthropometric indicators derived from photographic imaging

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Background

- Intra and inter-rater concordance studies are important to measure the reliability or reproducibility of evaluations.

- To determine which measurements are more reproducible and what is the smallest inter and intra observer difference that can be achieved. In this way, establish which are the measurements that have greater variability and that require more training to achieve a reliable measurement.

Background -Reliability 1

- Validity of photographic imaging for assessing standing height of preschoolers. Joni Beintema, Noel W. Solomons, Mónica Orozco, Rosario García, Rebecca Gwaltney, Heike Rolker & Colleen Doak. The photographic images of 200 preschool children were evaluated for estimation of standing height. The mean differences comparing measured and photographic height were statistically significant ($p<0.05$). The Pearson correlation coefficient was $r=0.988$ and the Lin concordance correlation was $r=0.987$.
- Anthropometric Measurements from Photographic Images. Patrick Chi-Yuen Hung, Channa P. Witana, and Ravindra S. Goonetilleke. The results of this study show that linear and circumferential measurements can be obtained using an image-based system within a certain accuracy and reliability. The measurement ‘quality’ seems to depend for the most part on the proper identification of anatomical landmarks and the characterization of body shape. Further investigation may be required to verify the external validity of the findings.

Background -Reliability 2

- An Image-Based Approach to Obtaining Anthropometric Measurements for Inertia Modeling. Marianne J. R. Gittoes, Ian N. Bezodis & Cassie Wilson. The presented image-based approach provides a successful alternative to direct measurement for obtaining anthropometric measurements required for customized inertia modeling. The image-based approach is potentially beneficial for indirectly deriving comprehensive anthropometric measurements from large samples of subjects or elite athletic performers for whom time-consuming data collections may be undesirable.

Objectives

- To determine the inter and intra rater reliability when using photographic imaging for the estimation of arm length (AL), height (H), leg length (LL), trunk by difference (height - leg) (T), trunk-to-leg ratio (TLR) and trunk-to-height ratio (THR) in children of 48-95 months.

Methods and Procedures

Participants

120 children from three sites (3 different SES)

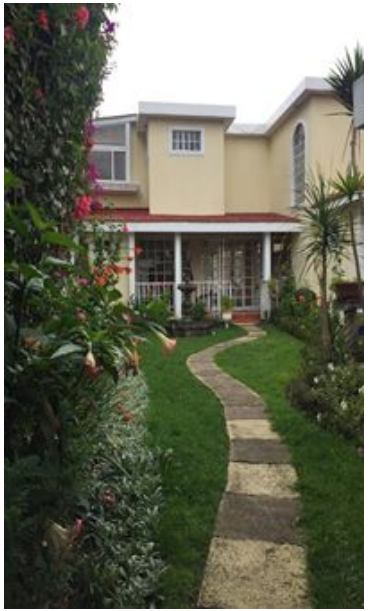
Santa Maria (Low SES), La Esperanza (Med) and Quetzaltenango (High SES)

40 kids from each community

- Children from 4 to 7 years old

  From each community, 10 kids from each age group

- 50% girls, 50% boys



Study Sites

- The chosen communities represent a spectrum of social economic levels

Santa Maria

(Public Schools)

La Esperanza

(Public Schools)

Quetzaltenango

(Private schools)

Lower Socio-Economic Class

Higher Socio-Economic Class

Measurements

Photographic Measurements

- Arm length
- Leg length
- Height
- Trunk
- Sleeve-cuff length

Photographic Method

- 3 poses for each child
- 3 pictures taken of each pose, best picture of each pose used for analysis
- Camera setup 1.8m away from the platform
- Colored tape placed on the children’s shoulder, wrist and across the ridge of the iliac crest

Photographic Method-Posture 1

- Child stands with back towards the platform, feet straight, and eyes forward
- The right arm is in the same plane of the post
- Used to measure arm length by comparing letters and numbers on the post to the tape placed on the shoulder and wrist

Photographic Method-Posture 2

- Child stands with back towards platform, feet straight, and eyes forward
- The right hand in placed on the chest “Salute” posture
- Used to measure total height and leg length from print out of photograph
  * Measured to the nearest mm
  * Trunk calculated as height-leg length

Photographic Method-Posture 3

- Child stands with back towards platform, feet are separated and straight, and facing the camera
- Arms are relaxed at the sides
- Used to measure total height, leg length, sleeve length, and waist width from print out of photograph

  * Measured to the nearest mm

  * Trunk calculated as the difference between height and leg length

Analysis

- Photographic images referenced as ratios derived from measurements of print outs
- R software used to conduct statistical tests
- Correlation: Pearson’s Correlation Coefficient for normal data
- Lin’s Concordance Coefficient used to evaluate inter-reliability between methods and observers 2 by 2 and 3 by 3.

Results

Inter-Reliability Findings

n= 112

	Comparison	Lin 2 Way	Pearson	95% CI	Pearson P Value
Height (mm)	A-B	0.99	0.99	(0.99, 0.99)	< .001
	B-C	0.99	0.99	(0.99, 0.99)	< .001
	C-A	1.00	0.99	(0.99, 0.99)	< .001
Leg (mm)	A-B	0.99	0.99	(0.91, 0.99)	< .001
	B-C	0.99	0.99	(0.99, 0.99)	< .001
	C-A	1.00	0.99	(0.99, 0.99)	< .001

Inter-Reliability Findings

n= 112

	Comparison	Lin 2 Way	Pearson	95% CI	Pearson P Value
Trunk (Height-Leg) (mm)	A-B	0.94	0.94	(0.91, 0.96)	< .001
	B-C	0.95	0.95	(0.99, 0.99)	< .001
	C-A	0.97	0.97	(0.99, 0.99)	< .001
Arm (cm)	A-B	0.98	0.98	(0.97, 0.99)	< .001
	B-C	0.96	0.95	(0.97, 0.99)	< .001
	C-A	0.97	0.97	(0.97, 0.98)	< .001

Inter-Reliability Findings

n= 112

	Comparison	Lin 2 Way	Pearson	95% CI	Pearson P Value
Trunk-to-leg Ratio	A-B	0.95	0.95	(0.93, 0.96)	< .001
	B-C	0.96	0.96	(0.96, 0.98)	< .001
	C-A	0.97	0.97	(0.95, 0.97)	< .001
Trunk-to-Height-Ratio	A-B	0.95	0.95	(0.93, 0.97)	< .001
	B-C	0.96	0.96	(0.96, 0.98)	< .001
	C-A	0.97	0.97	(0.95, 0.98)	< .001

Inter-Reliability Findings

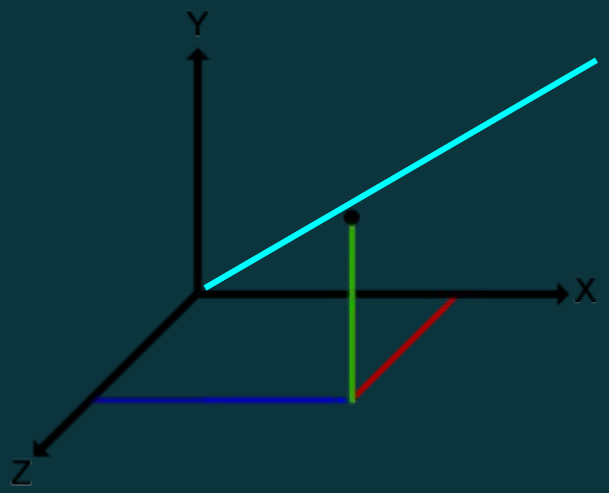
n= 112

	Comparison	Lin 2 Way	Pearson	95% CI	Pearson P Value
Sleeve-Cuff Length	A-B	0.97	0.97	(0.95, 0.99)	< .001
	B-C	0.95	0.95	(0.93, 0.97)	< .001
	C-A	0.95	0.95	(0.93, 0.96)	< .001
Sleeve-cuff:Height Ratio	A-B	0.95	0.95	(0.93, 0.97)	< .001
	B-C	0.92	0.92	(0.89, 0.94)	< .001
	C-A	0.92	0.92	(0.89, 0.95)	< .001

Inter-Reliability Findings

	Lin 3 Way
Estimated Ratio	
Trunk:Leg ratio	0.84
Trunk:Height ratio	0.84
Sleeve-cuff:Height ratio	0.78
Estimated Length	
Height (mm)	0.91
Leg length (cm)	0.93
Trunk length (cm)	0.74
Sleeve-cuff length (cm)	0.84
Arm length (cm)	0.88

n= 112



Intra-Reliability Findings

	Mean ± SD				Lin Concordance Coefficient		
	Ass. 1	Ass. 2	Ass. 3	*p*	1v2	1v3	2v3
Estimated Ratio							
Trunk:Leg ratio	0.716±0.075	0.718±0.069	0.719±0.075	0.956	0.96	0.96	0.95
Trunk:Height ratio	0.416±0.025	0.417±0.023	0.417±0.025	0.937	0.96	0.95	0.95
Sleeve-cuff:Height ratio	0.103±0.023	0.103±0.023	0.103±0.024	0.859	0.95	0.96	0.96

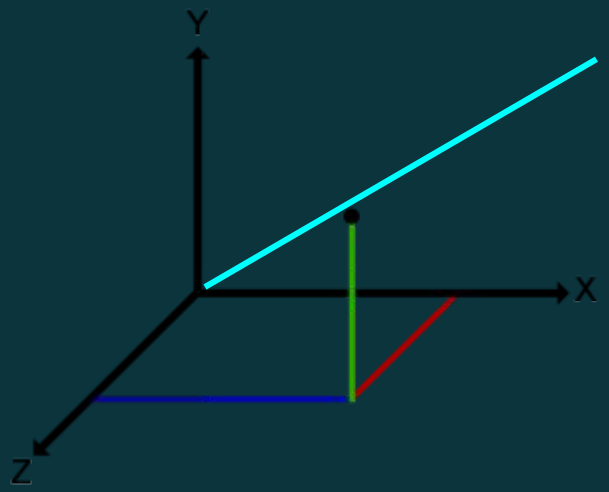
Intra-Reliability Findings

	Mean ± SD				Lin Concordance Coefficient		
	Ass. 1	Ass. 2	Ass. 3	*p*	1v2	1v3	2v3
Estimated Length							
Height (mm)	196.458±15.723	195.875±15.668	195.733±15.828	0.931	0.99	0.99	1.00
Leg length (cm)	63.390±7.333	63.280±7.085	63.270±7.268	0.913	0.99	0.99	0.99
Trunk length (cm)	44.890±2.750	45.000±2.905	45.010±2.848	0.988	0.96	0.96	0.96
Sleeve-cuff length (cm)	11.231±3.037	11.295±2.958	11.313±3.083	0.968	0.96	0.97	0.96

Intra-Reliability Findings

	Lin 3 Way
Estimated Ratio	
Trunk:Leg ratio	0.81
Trunk:Height ratio	0.80
Sleeve-cuff:Height ratio	0.74
Estimated Length	
Height (mm)	0.90
Leg length (cm)	0.91
Trunk length (cm)	0.73
Sleeve-cuff length (cm)	0.81

n= 120



Discussion-Inter-Reliability Findings

- **Lin Concordance Coefficient**

  The data was higher for inter-reliability for 2 of the photographic image parameters; Height and leg length (1.00), the rest of the data was almost perfect (>0.90).

- **Pearson**

  It shows very strong correlation for all of the data entered.

- **Pearson P Value**

  All data obtained is statistically significant.

Discussion-Intra-Reliability Findings

- **Lin Concordance Coefficient**

  The data was higher for intra-reliability for 2 of the photographic image parameters; Height and leg length (>0.90), the rest of the data was substantial (>0.80), except for trunk (0.73) that was moderate.

- **Pearson**

  It shows very strong correlation for all of the data entered.

- **Pearson P Value**

  All data obtained is statistically significant.

Discussion

Lin concordance correlations were high for inter and intra reliability for photographic image parameters

- Trunk-to-leg ratio
- Trunk-to-height ratio
- Arm length
- Sleeve-cuff length
- Height
- Leg length

Expressions of Gratitude

Thank you CeSSIAM for this great opportunity!

Fieldwork and research it's always exciting and I couldn't have done it without my amazing teammates Nicole Stephan and Jifan Wang. Dr. Solomons, Rosario García, Alejandra Zamora and Deborah Fuentes, for helping us out throughout this whole process.

Related Literature

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