Optimization of technical photographic variables to assess newborn length using photographic imaging

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BACKGROUND

Pediatric growth assessment is a valuable tool to determine whether the physiological needs for growth and development of a child are being met (WHO, 2003). A short length and low weight at birth, in relation to the gestational age of a baby, has been associated with adverse short- and long-term outcomes (Bale et al, 2003).

The current gold-standard technique for measuring newborn recumbent length is inaccurate and potentially dangerous to the fragile newborn, which calls for the development of a safer and more accurate method. In the past, we explored the use of standardized photographic images as a potential method to measure length in newborns, with corrigeable limitations in accuracy.

OBJECTIVE

To refine a photographic technique used to assess newborn anthropometry by studying the effect of several technical photographic variables on intrinsic error, using inanimate baby models.

METHODS

1. Photographic variables assessed to optimize length accuracy:
   - Vertical (50, 75, and 100 cm) and horizontal (left, center, and right) camera displacements.
   - Reference object size (5, 10, 20, and 25 cm).
   - Camera type (digital vs smartphone).
   - Zoom magnification (pre vs post).

2. Total length estimation from photographs: Calculated by adding up the total length of the models, measured in mm on a paper print-out, computer or smartphone screen. Then it was converted to actual length in cm in reference to the object. Estimated measurements were compared to infantometer measurements for accuracy.

3. Statistical analysis:
   - Descriptive statistics were obtained for each group within a variable of interest, as well as a test of comparison between the means of the different groups – such as a paired t-test or one-way ANOVA test. Bonferroni post-hoc testing was used to compare between groups in ANOVA testing.

RESULTS

Results: Increasing focal length reduces error, with optimal heights of 10 cm (0.07% error), 1 m (0.03% error), and 2 m (0.01%) error. Variance in procedures for zoom and in reference bar length do not appear to affect length estimation. Individual camera optics may play a role in refining this technique in the future. The type of screen or print by which the length is measured does not affect percent error. Therefore, the length can be measured on whichever screen or print is most convenient for the investigator.

- The reference length does affect percent error, but not as expected. On average, the 5 cm reference had 1.79% less percent error than the 10 cm reference. No other significant relationships were found. Reference length does not appear to play an important role in minimizing error.

- The camera angle affects the error, even when the objective and reference are in the same vertical plane. The camera must be centered over a focal point, equidistant to the baby and reference bar, in order to get precise images.

- Zooming the camera before taking the photo versus zooming the photo affects percent error, with a greater error expected when zooming before the photo.

DISCUSSION/CONCLUSION

- The greatest camera heights began to underestimate the length measurement, with an “ideal” camera height between 75 cm and 1 m.

- The greater the vertical displacement between the model and the reference bar, the greater the error. Therefore, when applying this technique to length assessment in babies, the baby and the reference bar should be in the same vertical plane.

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- The reference bar length does affect percent error, but not as expected. On average, the 5 cm reference had 1.79% less percent error than the 10 cm reference. No other significant relationships were found. Reference length does not appear to play an important role in minimizing error.

- Zooming the camera before taking the photo versus zooming the photo after taking the photo affects percent error, with a greater error expected when zooming before the photo.

- Individual camera optics may play a role in refining this technique in the future. The type of screen or print by which the length is measured does not affect percent error. Therefore, the length can be measured on whichever screen or print is most convenient for the investigator.

- These technical photographic variables can be optimized to minimize estimated length error, promising a new valid and comfortable technique for assessing birth-length in newborns.

REFERENCES


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