# UPPER BODY SEGMENT LENGTHS AS A PROPORTION OF HEIGHT IN CHILDREN

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**INTRODUCTION:** Most research studies in biomechanics directly measure body segment lengths via anthropometry or digitization of joint markers. There are circumstances in which estimating segment lengths in relation to height is desirable, such as in biomechanical modelling or in the classroom. One commonly used model for this purpose is that by Drillis and Contini (1966; cited in Winter, 2005). One problem with this model is that the initial data was derived from adults, and thus has potentially limited applicability to the study of biomechanics in children. The purpose of the present study was to compare actual selected upper body segment lengths measured via anthropometry to those predicted by Drillis and Contini and also to derive regression equations for those segment lengths based on height and age (separately for males and females).

**METHOD:** Height, sitting height, arm length, forearm length, and shoulder width were measured using standard anthropometric techniques as part of the Michigan State University Motor Performance Study. This yielded cross-sectional data with the number of subjects varying somewhat, but generally between 200 and 400 for each age group and sex combination. Each subject's height was then used to predict each segment length using Drillis and Contini, and the difference between actual and predicted values was calculated. In addition, linear regression was applied to arrive at new prediction equations for segment lengths on the basis of height and age.

**RESULTS:** Segment lengths derived from Drillis and Contini were highly correlated with actual lengths ($0.95 < r < 0.98$), but under predicted arm length, forearm length, and sitting height, and over predicted shoulder width, with a slight age and sex effect. Mean over prediction as a percent of actual segment length was about 5% for the arm, 10% for the forearm, 9% for sitting height, and a mean under prediction of about 16% for shoulder width. Regression equations for each segment incorporating height and age had r values ranging from 0.96 to 0.98 and resulted in generally better predictions of segment lengths (less than 1-3% difference, on average) while reducing the age effect.

**DISCUSSION:** The systematic over and under prediction of segment lengths derived from Drillis and Contini may have been caused by differences in measurement techniques, but is more likely due to differing body proportions between children and adults. Regression equations derived from data in the present study yielded improved predictions of segment lengths on the basis of height and age.

**CONCLUSION:** The model of Drillis and Contini systematically over or under predicted segment lengths for the children in the present study. Regression models incorporating height and age yielded improved predictions. These regression equations may be useful for those producing biomechanical models of the upper body and for students of biomechanics.

**REFERENCES:**

Winter, David A. (2005). *Biomechanics and motor control of human movement* (3rd ed.). Hoboken, NJ: John Wiley & Sons.