

Strength Increases as a Function of Age in Children and Adolescents, Independent of Lean Mass

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Background

Appendicular lean mass (ALM), which is a surrogate measure of appendicular skeletal muscle mass, can be easily measured by a dual-energy X-ray absorptiometry (DXA) scanner. The amount of muscle a child has is the main determinant of their strength, however other developmental factors may change the relationship between strength and muscle mass. The current study tested the hypothesis that strength increases as a function of age in children and adolescents independently of ALM; and that even after controlling for lean mass and age, males have greater strength than females.

Methods

The hypothesis was tested by measuring strength (peak torque) in a racially and ethnically diverse sample of 190 children and adolescents in the Shape Up! Kids study (age, $X \pm SD$; 11.59 ± 3.36 yrs). Peak Torque measurements were taken on a Biodex System 4, and ALM was evaluated with Hologic Discovery A DXA system. Stepwise multiple regression models were developed with strength as the dependent variable and ALM, age, and gender as covariates.

Results

The developed model including strength as the dependent variable and age, gender, and ALM as covariates showed a combined R^2 of 0.77 with girls separately, R^2 , 0.65 and boys R^2 , 0.83. Using strength as the dependent variable, age, gender, and ALM were all significant ($p < 0.05$) covariates. Similar trends were observed when age was replaced with Tanner Stage; strength/ALM increased with Tanner Stage.

BOYS <i>Regression Statistics</i>	
Multiple R	0.915585943
R Square	0.838297619
Adjusted R Square	0.834353658
Standard Error	23.52476736
Observations	85

GIRLS <i>Regression Statistics</i>	
Multiple R	0.808046574
R Square	0.652939266
Adjusted R Square	0.646134154
Standard Error	20.71374972
Observations	105

ALL <i>Regression Statistics</i>	
Multiple R	0.87916416
R Square	0.772929621
Adjusted R Square	0.769267195
Standard Error	22.63009767
Observations	190

Discussion

Strength in children and adolescents is strongly related to ALM, a surrogate measure of muscle mass. After controlling for ALM, age and gender were additional strength determinants, suggesting that strength is determined by mechanisms beyond that accounted solely by muscle mass. Our results also suggest that even after controlling for lean mass and age, that boys are stronger than girls.

Conclusion

Our results suggest that even after controlling for lean mass and age, that boys are stronger than girls.