A Cluster Mediation Analysis Confirms the Validity of the “Fat but Fit” Paradigm in Children's Cognitive Function and Academic Achievement

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Abstract
Objective: To evaluate the fat but fit conceptual model, testing whether this paradigm for body mass index (BMI) and maximum rate of oxygen consumption (VO\textsubscript{2max}) exists in schoolchildren and whether executive functions mediate the relationship between fat but fit categories and academic achievement. Study design: Cluster cross-sectional analyses of data from 554 children aged 9-11 from Cuenca, Spain. BMI, VO\textsubscript{2max}, core executive functions (inhibition, working memory, and cognitive flexibility) and academic achievement (language and mathematics). Results: Cluster analysis of BMI and VO\textsubscript{2max} z-scores resulted in a 4-cluster solution that could be interpreted according to fat unfit, unfat unfit, fat fit, and unfat fit categories. ANCOVA models confirmed an increasing trend by cluster category in terms of VO\textsubscript{2max} levels and, conversely, a decreasing trend in terms of adiposity variables. These models also confirmed that children in the fat fit and unfat fit categories scored higher than their peers in the fat unfit and unfat unfit categories. Mediation analyses using fat but fit clusters as multicategory independent variable, executive functions as mediators, and academic achievement as outcome variable showed that the positive association between the BMI-VO\textsubscript{2max} clusters and academic achievement was mediated by inhibition levels in fat fit and unfat fit individuals, by working memory levels only in those classified as fat fit, and by cognitive flexibility only in unfat fit individuals. Conclusions: This study confirms the validity of the 4-cluster conceptual model regarding BMI and VO\textsubscript{2max} and reinforces the predictive validity, proving that fitness levels are able to counteract the detrimental effect of obesity on academic achievement.