Rebecca Copper – Waist to height ratio in relation to time to run 550m in primary school children in the Waikato region.

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Background:
Relationships between excess body fat, body fat distribution, and body proportions with physical fitness are important to explore because emphasis is placed on monitoring these health markers during interventions aimed at improving child health. It is known that physical activity and therefore cardiorespiratory fitness are essential for health and life. Therefore can improved physical functionality such as an ability to run 550 m, a measure of cardiorespiratory fitness, be inferred from anthropometric measures in children? There was no published evidence for children on the relationship of the waist to height ratio; a measure of abdominal fatness, in relation to cardiorespiratory fitness. Furthermore the external and relatively fixed influence of ethnicity and social deprivation on physical fitness and interrelations with body fatness are rarely examined together. Explorations undertaken in this body of work aimed to increase the understanding of the relationships of anthropometric measures with a cardiorespiratory fitness measure of 7 and 10-yr old New Zealand (NZ) children from different socioeconomic levels and ethnic groups.

Methods:
Project Energize is a through-school nutrition and physical activity program provided to Waikato NZ primary schools (land area 25,000 km2) since 2004. An extended evaluation of the program was undertaken in early 2011. Cross sectional data including school demography, ethnicity, location, anthropometric measurements, blood pressure, food and physical activity knowledge questions and time taken to run 550 m were measured, from more than 5000 children, aged mostly 7 or 10-yrs old. From the data a sub-set was utilised for this body of work including, height, weight, waist circumference, and total body fat by bioimpedance analysis measures. Body mass index and waist to height ratio were derived and the physical fitness test was time taken for children to run 550 m (run-time550m) on an outdoor grass track. All school decile levels (a scale where 1 is the most and 10 the least socially deprived, which were ranked and grouped low, medium or high decile) were represented and one third of participants were self-identified as Maori. Just over half the children were NZ European and the remainder were represented by Pacific and Other ethnic groups. Potential confounding effects of asthma (17% prevalence) and rurality (64% of the participants lived rurally) were also examined. To answer the main research question, stepwise multiple linear regression analysis was used establish the most influential predictors of run-time550m.

Results:
The strongest predictors of run-time550m were, fat mass percent, waist to height ratio, body mass index, waist circumference and school decile group (low, medium or high). The best four models for each age group (7-yr olds, n = 2634; 10-yr olds, n = 2466) to predict run-time550m included: waist to height ratio OR body mass index OR waist circumference OR fat mass percent+age (years)+ gender (girl)+ school decile (low)+ school decile (medium).

Similarly in all models, for the 7 and 10-yr old groups, up to 27% and 39%, respectively, of the total variation in run-time550m could be explained. Before and after adjustments the waist to height ratio and fat mass percent appeared to be the most influential anthropometric measurement for prediction of cardiorespiratory fitness in these children. After adjustments, for every 0.01 cm/cm increase waist to height ratio, time to complete 550 m increased in 7-yr olds, 2.8% (95% CI; 2.4%, 3.4%) and in 10-yr olds, 3.3% (2.9%, 3.8%). Compared to body mass index where for every 1 kg/m2 increase there was a 2.1% (95% CI; 1.9%, 2.3%) in 7-yr olds and in 10-y olds, 2.2% (2.0%, 2.3%) increase in run-time550m. A separate analysis demonstrated waist to height ratio increased 0.013 cm/cm for every 1 kg/m2 increase in body mass index after adjusting for age and gender, R = 0.86, P > 0.0001. School decile was an important covariate in each model where the lower decile group took on average 7% and medium decile group 4% longer to run 550 m than the high decile group, after adjustments for body fatness, age and gender. Run-time550m decreased with age and girls ran more slowly than boys. Ethnic group, asthma, and rurality were not significant predictors in these models.

Conclusion:
When examining the differences between proxy body fatness measurements and association with running performance an increase in waist to height ratio was associated with an increase in run-time550m, suggesting that increased abdominal fat volume was associated with reduced cardiorespiratory fitness in children. Additionally social deprivation level had a significant impact on cardiorespiratory fitness independent of body fatness or body size. The waist to height ratio and run-time550m are simple measures to use in children to assess risks of excess adiposity and poor physical fitness.