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Genetic and Environmental Influences on Children's Caloric Compensation

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Background: Children on average adjust energy intake at meals proportional to energy previously consumed ("caloric compensation", CC). Although children differ in CC ability, reasons for this variability are poorly understood.

Aim: To test the familial correlation of CC, and genetic and environmental influences on CC, in a pediatric twin sample.

Participants: 118 children from 59 same-sex twin pairs (37 MZ, 22 DZ). Children were 3 - 7 yrs old (68 girls and 50 boys).

Measures: CC was measured using lab procedures whereby children consumed a multi-item lunch on two separate occasions. 30 minutes prior to each meal, children consumed either a low-(3 kcals) or high-calorie (150 kcals) carbohydrate drink. BMI was evaluated.

Statistics: T-tests compared total energy intake following the low- and high-calorie preloads. A "Compensation Index" (COMPX) quantified degree of energy compensation by children. An intra-class correlation coefficient (ρ) evaluated whether CC abilities were associated among family members. Structural equation modeling tested the relative influence of additive genetic factors, "shared environmental" factors, and "unique environmental" factors on child CC ability.

Results: Children consumed significantly more total energy following the low-calorie (354.24 ± 247.22 kcals) than the high-calorie preload (255.56 ±199.06 kcals), $p<.001$. The mean COMPX score of 68.09% indicated that the average child exhibited incomplete compensation. Across all families there was evidence for familial correlation of CC when adjusting for age, sex, and BMI ($\rho=.26$, $p=.02$). Biometric twin analyses indicated that, per the best fitting model, ~25% and ~75% of the variance in CC was due to common and unique environmental influences, respectively. The genetic variance component was not significant.

Discussion: CC appears to be familial. Variation in CC was partially due to common environmental factors. Results should be interpreted in light of statistical power and design issues that affect the definition of 'common environment.'

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Low Intakes of Dairy Products in Early Childhood May Increase Body Fat Acquisition

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A few studies among adults suggest that increased dairy intake may result in weight loss. Only about 30% of American children consume the recommended servings of dairy/day. We used data from 99 children followed over twelve years in the Framingham Children's Study (FCS) to determine whether dairy intake impacted change in body fat from preschool to early adolescence. Diet was assessed yearly by means of 2-4 sets of 3-day diet records. Yearly anthropometry measures included height and weight (BMI), and triceps, subscapular, suprailiac, and abdominal skinfolds. We calculated slopes from 3 to 12 years of age for each anthropometry measure. Girls averaged 1.6 servings/day of dairy while boys consumed an average of 2.1 servings/day. Children in the lowest tertile of dairy servings at 3 to 9 years had statistically significantly lower ($p\leq 0.05$) energy-adjusted intakes of saturated fat, protein, calcium, magnesium, and vitamins A and D compared with children in higher tertiles. Carbohydrate intakes were significantly higher among children with the lowest dairy intakes. We used analysis of covariance to examine the effect of dairy intake on the mean change in body fat from 3 to 12 years of age, adjusting for age, physical activity levels, % calories from saturated fat, baseline body fat, and maternal education. Children in the lowest tertile of dairy servings/day had statistically significantly greater gains in BMI (0.57, 0.40, and 0.42 kg/m^2 increase/year in the low to high tertiles, respectively) and sum of 4 skinfolds (7.0, 5.2, and 4.9 mm increase/year, respectively) than did children in the upper 2 tertiles. By the time of early adolescence (10 to 13 years), children in the 3 tertiles of dairy intake (from low to high) had a mean BMI of 20.4, 19.8, and 19.0 and a mean sum of 4 skinfolds of 69.2, 66.4, and 61.7 mm, respectively. This study provides no evidence that dairy intake has an adverse impact on body fat change in developing children and suggests that low levels of dairy intake may be associated with a greater acquisition of body fat during childhood.

MEASUREMENT OF PHYSICAL ACTIVITY

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Comparison of Two Survey Methods To Obtain Physical Activity Information for Adolescents

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This study determined the test-retest reliability, validity, and feasibility of a three-day activity approach (SAPAC) and a three-day time approach (3DPAR) survey instrument for obtaining moderate-to-vigorous physical activity (MVPA) information in adolescents. A sample of 205 female and 116 male adolescents (13±1 yr, mean±SD) completed two, three-day physical activity recalls using the SAPAC and 3DPAR surveys that had the same list of physical activities. For the SAPAC survey the respondents reported the minutes in each activity for each day. For the 3DPAR survey the respondents reported the predominant activity completed for each 30-minute segment of all three days. The participants wore an Actigraph accelerometer for the same three days, which was used as the criterion measure for physical activity. The 3DPAR survey took longer to complete (3DPAR = 31±10, SAPAC = 28±8 min; $p = 0.022$). The overall (2-day) test-retest correlations for MVPA for the 3DPAR were significant for both genders ($p < 0.001$); however, correlations for the SAPAC were only significant for the girls ($p < 0.0001$) and not the boys ($p = 0.50$). Also, the correlations were higher for the 3DPAR than the SAPAC (girls: $r = 0.728$ vs. 0.487; boys: $r = 0.868$ vs. 0.110). The overall 3-day correlations between MVPA determined by the surveys and accelerometer counts were low ($r < 0.3$). MVPA determined from the 3DPAR had higher correlations with MVPA determined from Actigraph than from the SAPAC (girls: $r = 0.264$ vs. 0.148; boys: $r = 0.191$ vs. 0.011, respectively). In conclusion, early adolescents appear to have limited ability to provide reliable and valid physical activity recalls over a three-day period. Also, the data suggest that for both genders, the 3DPAR correlates more highly, and has higher test-retest reliability than the SAPAC for obtaining MVPA information from adolescents.

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Imputation of Missing Data When Measuring Physical Activity by Accelerometry

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Accelerometry has emerged as an important means of assessing physical activity and is currently being used in the group-randomized Trial of Activity in Adolescent Girls (TAAG) to examine the effect of a school and community-based intervention on physical activity. Counts corresponding to activity intensity are stored at the end of each user-specified time interval (e.g., 30-s). Accumulated counts over several days can be summarized as minutes per day of moderate to vigorous physical activity (MVPA) by tallying the number of counts above an established threshold. However, if counts are missing for numerous intervals or entire days, the estimated minutes of MVPA based only the observed data may be biased.

We contrasted two methods to impute missing data (EM algorithm, and multiple imputation [MI] using the SAS MI procedure) and evaluated these with a simulation experiment based on relatively complete actigraph data collected over 7 days on 181 girls in a TAAG sub-study. We deleted 20% of data values (a) at random, or (b) in an informative way with higher probability of missingness at upper levels of BMI and lower levels of physical activity. The number of minutes of MVPA was imputed for missed intervals during the day (simulation series I), or for the entire day when the monitor was worn less than 70% of a typical day for this sample (simulation series II). The average daily minutes of MVPA based on the complete data was 24.5 ± 13.4 minutes. For simulation series I and condition (a), the summary statistics using the EM and MI strategies were 24.5 ± 13.1 and 25.3 ± 12.8 minutes, respectively. The mean bias (= true - imputed) were 0.01 and 3.8 minutes per day, respectively. Under condition (b), the corresponding summary statistics were 25.1 ± 13.3 and 25.7 ± 12.9 minutes, with mean bias of 2.4 and 3.3 minutes per day, respectively. Simulation