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Very low levels of energy expenditure among pre-adolescent Mexican-American girls

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Abstract

We assessed activity energy expenditure (AEE) in Mexican-American (MA) and European-American (EA) children. Total energy expenditure (TEE) and resting energy expenditure (REE) were measured using doubly labeled water (DLW), from which AEE and physical activity level (PAL) were calculated. Groups were comparable for age, sex and body mass index (BMI). REE was not different among groups. The boys did not differ in TEE, AEE, or PAL (MA vs. EA, respectively: TEE, 7.9 ± 1.5 vs. 7.5 ± 0.9 $MJ.d^{-1}$, AEE: 64.9 ± 24.7 vs. 65.3 ± 22.3 $kJ.kg^{-1}.d^{-1}$; PAL: 1.57 ± 0.18 vs. 1.58 ± 0.19 $kJ.kg^{-1}.d^{-1}$). MA girls had lower TEE, AEE, and PAL than EA girls (total EE: 6.8 ± 0.9 vs. 8.1 ± 0.8 $MJ.d^{-1}$; AEE, 37.3 ± 15.9 vs. 64.9 ± 24.7 $kJ.kg^{-1}.d^{-1}$; PAL, 1.40 ± 0.12 vs. 1.57 ± 0.18; $P<0.005$). Results suggest that these MA girls were expending less energy than EA children of comparable body size due to reduced activity energy expenditure.

Keywords

physical activity energy expenditure; doubly labeled water; ethnicity

Introduction

As of 2002, Childhood overweight was more common in Mexican-American (19.2%, 22.0 and 16.2%, boys and girls respectively) and black children (20.0%, 16.4 and 23.8%, boys and girls respectively) than in white children (16.3%, 17.8 and 14.8%, boys and girls respectively) (1). The reasons for such racial and ethnic disparities remain controversial. Some studies report differences in the components comprising energy expenditure (EE) between racial or ethnic groups (2–7), while others attribute differences to behavioral lifestyle factors such as differential participation in organized sports (8,9) or non-equivalent familial environments (10). The aim of the current study was to perform a preliminary investigation of EE in healthy MA and European-American (EA) children with the future goal of investigating whether or not differences in EE contribute to differences in overweight among MA children.

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Conflict of interest statement: None

Research Methods and Procedures

The site samples included twenty first-generation MA children from the western suburbs of Chicago, IL and seventeen EA children from Bethesda, Maryland, aged 6–10 years. The MA study was approved by the Institutional Review Board of the Loyola University of Chicago, Illinois, and the EA study was approved by the National Institute of Child Health and Human Development (NICHD) Institutional Review Board (www.clinicaltrials.gov NCT00001522).

Body composition was measured using the stable isotope-dilution method (11). Fat free mass (FFM) was calculated by dividing the average total body water by a pediatric age-specific hydration constant (12). Fat mass (FM) was calculated as the difference between body weight and FFM. Height was measured to the nearest 0.1 cm using a wall-mounted stadiometer and body weight was measured to the nearest 0.1 kg using a calibrated electronic scale (Seca Corp, San Jose, CA and Scale-Tronix, Wheaton, IL). Height and weight measurements were used to calculate BMI as weight (in kg)/height^2 (in m).

Energy expenditure

REE ($MJ \cdot d^{-1}$) was measured for ≥30 minutes, using the DeltaTrac II, (Viasys Medical Systems, Palm Springs, CA), early in the morning, following an overnight fast to determine the average REE ($MJ \cdot d^{-1}$) using the equations of Weir (13). TEE ($MJ \cdot d^{-1}$) was measured over a period of either 7 (Bethesda based cohort) or 14 days (Illinois based cohort) using the DLW technique, as previously described (14) and which utilizes the average total body water measured using ^{18}O and deuterium. Sampling procedures were identical for both the MA and EA participants and all samples were analyzed at the same laboratory (15). The measurement of AEE has been described previously (16) and is calculated as: AEE = (0.94*TEE − REE) (17, 18). Similarly, the PAL has also been previously documented (19) as the ratio of TEE to REE.

Statistical methods

The primary outcomes were the relationship between ethnicity and components of energy expenditure, evaluated in an analysis of variance performed using Stata/SE (Version 9.0; StataCorp LP, College Station, TX) Gender and body mass were also included in the model. Multivariate regression analyses were also performed with REE, TEE and AEE as the dependent variables and age, body weight, fat free mass and % body fat as independent variables. Activity was examined in two different ways: as AEE per day adjusted for body weight, and as TEE adjusted for REE (PAL).

Results

The sample included 47 children, of which 20 were MA (10 girls and 10 boys) and 27 were EA (11 girls and 16 boys). Participant characteristics (Table 1) were comparable for age, weight, BMI, FFM, and % body fat. REE adjusted for covariates was not significantly different among groups.

MA children had a significantly lower TEE than EA children (Table 1, $P<0.05$), primarily due to a difference in the TEE in MA girls ($P<0.01$). Age, weight, % body fat, and FFM were all significant contributors to the final regression model for TEE ($P<0.001$).

AEE was also influenced by ethnicity, with the MA children having significantly lower levels than the EA children (Table 1, $P<0.01$), also almost exclusively due to the lower AEE in the MA girls ($P<0.005$). Differences remained significant between MA and EA girls when AEE was adjusted for body weight ($P<0.005$) or FFM ($P<0.01$). PAL was similarly influenced by ethnicity with MA girls having significantly lower levels of PAL than the EA girls ($P<0.005$).

Discussion

We found that AEE was significantly lower in MA girls, compared to EA girls and boys and contributed to an overall significantly lower TEE in the MA children compared to the EA children. Fontvieille et al. (2) reported similar observations in Pima Indians: Pima Indian girls engaged in lower levels of leisure time physical activity (P<0.01) than EA girls. Unlike the current study, lower EE was also found in Pima Indian boys compared to white boys, and in part, explained the higher adiposity reported in these Pima Indians. While in a more recent study comparing only MA boys and girls (20), physical activity was consistently lower in MA girls, independent of age (P>0.001). However, in our study, children were carefully matched for body weight and BMI, therefore we anticipated that AEE would be similar between the groups.

One possible explanation for the AEE discrepancy may be found in recent data examining physical activity behavior amongst minority children. Gordon-Larsen et al. (21) found the number of adolescents participating in the recommended amount of physical activity bouts per week to be similar amongst MA, African-American, and EA boys, whereas amongst the girls, a significantly lower number of MA and African-American girls met the recommended physical activity guidelines compared to the EA girls. Although the seasonal data are not presented here, we found slight differences in AEE for the MA boys, with higher levels being observed during the summer months. In contrast, there was no difference in TEE or AEE among the MA girls, with uniformly low mean rates observed in both winter and summer months. Due to our small sample, we chose to present average EE data for all groups. It is clear, however, that there may well be important seasonal differences in AEE (22,23).

We did not find any ethnic or gender differences in REE; similarly, no differences in REE adjusted for body composition have been reported in studies between Pima Indian and EA children (2), or between MA and EA girls (24).

Limitations for the current preliminary study are that data were collected at two research sites and that sociodemographic variables which may impact physical activity patterns were not available for study. The magnitude of the observed effects, i.e., 45% lower AEE between MA and EA girls and 37% lower AEE between MA girls and both samples of boys, suggests further investigation among urban MA children in temperate climates may well be warranted.

In conclusion, this preliminary study suggests MA girls may expend less energy than EA girls of comparable body size due to reduced physical activity. Lower EE may be an important determinant of body weight later during adolescence and adulthood and, therefore, provide a conceivable explanation for the divergent obesity prevalence rates observed between EA and MA women.

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Table 1

Participant characteristics for Mexican American (MA) and European American (EA) girls and boys.

	Girls		Boys	
	MA	**EA**	**MA**	**EA**
N	10	11	10	16
Age (y)	8.3 ± 1.2	8.1 ± 1.0	7.6 ± 1.0	8.0 ± 1.0
Height (cm)	132.0 ± 9.2	132.8 ± 8.1	127.7 ± 4.2	129.4 ± 6.7
Weight (kg)	36.6 ± 11.2	35.4 ± 6.9	31.4 ± 6.1	32.1 ± 7.3
BMI (kg/m^2)	20.7 ± 4.4	19.9 ± 2.4	19.1 ± 2.9	19.0 ± 3.0
Fat-Free Mass (kg)	23.1 ± 4.5	24.4 ± 3.7	21.6 ± 2.5	22.9 ± 3.6
% Body Fat	34.7 ± 9.7	30.0 ± 7.9	29.8 ± 7.8	27.4 ± 7.8
TEE ($MJ \cdot d^{-1}$)	6.86 ± 0.93 [a]	8.09 ± 0.84 [b]	7.55 ± 0.90	7.92 ± 1.50 [b]
REE ($MJ \cdot d^{-1}$)	4.99 ± 0.64	4.92 ± 0.55	4.91 ± 0.46	4.99 ± 0.58
TEF ($MJ \cdot d^{-1}$)	0.41 ± 0.06	0.49 ± 0.05	0.45 ± 0.05	0.48 ± 0.09
AEE ($MJ \cdot d^{-1}$)	1.47 ± 0.61 [a]	2.68 ± 0.89 [b]	2.19 ± 0.78 [b]	2.46 ± 1.00 [b]
AEE ($kJ.kg^{-1} \cdot d^{-1}$)	42.6 ± 18.2 [a]	79.3 ± 31.3 [b]	71.4 ± 27.4 [b]	75.1 ± 22.9 [b]
PAL	1.40 ± 0.12 [a]	1.66 ± 0.22 [b]	1.57 ± 0.18 [b]	1.58 ± 0.19 [b]

* Characteristics with differing superscripts are significantly different, $p<0.05$