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Increased physical activity and reduced adiposity in overweight Hispanic adolescents

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Abstract

Purpose—Objectives of this study were to examine 1) whether changes in total PA (counts/minute, cpm) and time spent in moderate to vigorous PA (MVPA) are associated with changes in adiposity and 2) whether energy intake influences the relationship between changes in PA and changes in adiposity in overweight Hispanic adolescents.

Methods—Analysis included 38 overweight (BMI $\geq 85^{\text{th}}$ %ile) Hispanic adolescents with complete pre- and post-test data on relevant variables after participating in a 16-week intervention. The intervention treatment did not influence physical activity, so the sample was combined and randomization group was adjusted for in the analysis. Body composition by DEXA, 7-day physical activity by accelerometry, and dietary intake by 3-day diet records were assessed pre- and post-intervention.

Results—Within individuals, the mean increase of PA (n=19) and mean decrease of PA (n=19) was approximately 105 cpm. A 100 cpm increase in total PA was associated with a decrease of 1.3 kg fat mass and 0.8% body fat after adjusting for pre-test adiposity, PA, age, sex, and treatment (p < 0.05). Controlling for energy intake modestly strengthened the relationships between total PA and fat mass and percent body fat. Changes in MVPA were not related to changes in adiposity after controlling for total PA (p>0.05).

Conclusion—Increasing total PA by 28% (100 cpm) was associated with a decrease of 1.4 kg of fat mass and 1% body fat over 16 weeks in overweight Hispanic adolescents independent of intervention group assignment. Increases in total physical activity, as compared to MVPA, may be sufficient to improve body composition in overweight Hispanic adolescents.

Keywords

Obesity; children; Hispanic; accelerometer; youth; DEXA

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INTRODUCTION

National data from 2003–2006 indicate that 34% of adolescents in the United States are at risk for overweight and 17% are overweight (23). The prevalence rates among Mexican American adolescents are even higher than the national average, with 39% at risk for overweight and of those 21% are overweight (23). Hispanics are the largest and fastest growing ethnic minority in the United States(40); it is projected that by 2050 they will constitute almost one fourth of the U.S. population. These high rates of overweight among Hispanic adolescents are an important public health concern, because overweight adolescents are more likely to become overweight adults (31). In addition, being overweight contributes to the development of chronic diseases, such as type 2 diabetes, cardiovascular disease, and obesity-related cancers (19, 24). Given the rate at which this population is growing and the incidence rates of obesity and related co-morbidities among the youth of this population, it is imperative to identify the etiology of obesity in Hispanic adolescents.

Undoubtedly, there are many factors contributing to the alarming obesity rate, and one of the modifiable risk factors is physical activity (17, 26). Physical activity declines dramatically as children become adolescents (11, 16, 21). Only 8% of adolescents meet the CDC physical activity recommendations (60 mins/day of at least moderate-intensity activity (38)). While many studies in children and adolescents have found that increased physical activity is associated with decreased adiposity (20), there have been mixed reports (34). These discrepancies in results may be due to subjective methods used to assess physical activity and adiposity, such as questionnaires (28) and self-report body mass index. The use of objective and precise measures of physical activity and adiposity, such as accelerometry and DEXA (10, 28, 32, 42), can reduce measurement error, thereby increasing the ability to detect effects and elucidate the relationship between physical activity and adiposity (29). Another way to reduce error and increase the ability to detect an effect is to control for potential confounders, such as energy intake. Several studies have stated the importance of exploring the influence of energy intake when examining the relationship between activity and adiposity (6, 22, 35).

Recent cross-sectional studies have shown that objectively-measured physical activity is associated with adiposity in adolescents (1, 18), but to date, no study has examined the short-term effects of changes in objectively-measured physical activity on changes in adiposity, particularly in Hispanic youth. Therefore, the specific objectives of the current research were to 1) investigate whether changes in objectively-measured total physical activity and percent of time spent in moderate to vigorous physical activity (MVPA) are associated with changes in adiposity measures, including total fat mass, percent body fat, and visceral fat and 2) examine the influence of energy intake on the relationship between changes in physical activity and changes in adiposity.

METHODS

Participants

Study participants consisted of a sub-group of 54 overweight Hispanic adolescents with complete data who participated in a randomized nutrition and strength training type 2 diabetes prevention intervention. There was no effect of the intervention on physical activity; as a result, the sample of the current study combined the treatment groups and control for treatment group in the analyses. Participants were recruited from local area high schools, health care centers, community centers, word of mouth, and newspaper ads.

Except for the accelerometry methodology that will be described in detail below, a complete description of the study methods have been reported elsewhere (5), so only a brief overview

of the methods will be given here. Participants were 38 adolescents (19 girls, 19 boys) who had complete data for relevant measures at pre- and post-intervention (10 in the control group, 20 in the nutrition only group, 8 in the nutrition + strength training group). Participants included in the analyses were not significantly different than those excluded (gender, age, tanner stage, BMI%ile, weight, total fat or lean tissue mass, all $p > 0.10$). Informed written parental consent and child assent were obtained prior to testing. The Institutional Review Board of the University of Southern California approved the study.

Procedures

Screening visit—Participants arrived at the General Clinical Research Center after an overnight fast. A licensed pediatric health care provider conducted a medical history exam and determined sexual maturation (37). To screen for diabetes, an oral glucose tolerance test was conducted. Participants who met the following criteria were invited back for further testing: 1) age- and gender-specific BMI $\geq 85^{\text{th}}$ percentile; 2) Hispanic ethnicity, assessed by parental report of maternal and paternal Hispanic grandparents; 3) grades 9th thru 12th; 4) not currently taking medication or diagnosed with any syndrome or disease that influences fat distribution or insulin action; 5) not diagnosed with diabetes at screening or any major illness (e.g., cancer) since birth; 6) reported not participating in a structured exercise, nutrition, or weight loss program in the past six months.

Anthropometry and Body Composition—Weight and height were measured in triplicate using a beam medical scale and wall-mounted stadiometer, respectively, and then averaged. BMI percentiles for age and gender were determined using EpiInfo 2000, Version 1.1 (CDC, Atlanta, GA). Whole body fat, lean tissue, and percent body fat were measured by dual energy x-ray absorptiometry (DEXA) using a Hologic QDR 4500W (Hologic, Bedford, MA).

Energy intake and physical activity—To assess energy intake at pre- and post-test, participants completed 3-day diet records at home after being trained by study staff, who were supervised by a Registered Dietician. When compared to 24-hour recall and 5-day food frequency, the 3-day food record had the strongest agreement between observed and reported intakes(4). Staff clarified records when they were collected. Nutrition data were analyzed using the Nutrition Data System for Research (NDS-R version 5.0_35) developed by the University of Minnesota.

To assess physical activity (PA), subjects were instructed to wear Actigraph accelerometers (GT1M or 7164, Actigraph, LLC., Pensacola, FL) for seven days, except during water-based activities or when sleeping (27, 41). The Actigraph accelerometer is a reliable instrument, with an intraclass correlation of 0.99 (7). Accelerometers were set to monitor activity in 15-second epochs, which were collapsed to 60-second epochs during analysis. Data were reduced using an adapted version of the SAS code used for the 2003–2004 National Health and Nutrition Examination Survey available at http://riskfactor.cancer.gov/tools/nhanes_pam. A correction factor was applied to allow for comparison between the two Actigraph monitor models (3).

The amount of time the participant wore the device was determined by subtracting nonwear time from 24h. Nonwear time was defined by an interval ≥ 60 consecutive minutes of 0 activity counts, with allowance for 1–2 mins of counts between 0 and 100. Days with less than 6h of wear data were not considered acceptable, and participants with ≥ 2 days of acceptable accelerometry data at pre- and post-testing were included. There is no clear consensus on the length of acceptable monitoring periods (39), and the monitoring period of the current study was similar in duration to monitoring periods in other accelerometry

studies (2, 15, 16). At pre-test, participants with “valid” data wore the accelerometers for a mean $\pm$ SD of 12.6 ± 1.3 hours/day for 6.2 ± 2.3 days, which resulted in a mean monitoring period of 78.1 hours. At post-test the participants with “valid” data wore the accelerometers for 12.4 ± 1.4 hours/day for 5.6 ± 2.7 days, which resulted in a mean monitoring period of 69.7 hours. Statistical analyses were repeated in a subsample ($n=36$) of participants with ≥ 3 days of accelerometry data, and similar results were obtained.

Data from all acceptable days were averaged, and included the following variables: number of wear days, average number of minutes worn, total physical activity represented by average counts per minute (cpm) on wear periods from all valid days, percent of wear time spent in MVPA. The intensity cut-points applied to categorize MVPA were those used for adults and older adolescents in NHANES (≥ 2020 cpm (38)), because the current sample of adolescents had an average weight of 94 kg and median Tanner stage of 5, suggesting their biomechanics may be closer to those of adults than children. To ensure that results were not an artifact of the MVPA cut-point used, the analyses were replicated using the age-dependent MVPA cut-points based on the Freedson pediatric equation (8, 9).

Statistical Analysis—Paired sample t-tests were conducted to determine if there were pre- and post-test mean differences in anthropometric, adiposity, PA, or dietary measures. Pearson correlations were conducted to describe bivariate relationships. Multiple regression analyses were conducted to assess whether changes in PA (e.g., total physical activity and MVPA) were associated with changes in adiposity (e.g., DEXA data) after controlling for covariates. The following standard covariates were included in all models: sex, age, pre-test PA, pre-test adiposity, and intervention group. Additional covariates included pre- and post-test DEXA lean mass when change in fat mass was the dependent variable.

Residual diagnostic analyses were completed to ensure that the assumptions of regression were not violated. Further diagnostic analyses were also evaluated to identify collinear predictors, specifically to ensure that tolerance > 0.1 and variance inflation factor < 10 . For the regression models, unstandardized beta (B) coefficient estimates, standard errors, and p-values are reported. Throughout the regression analyses, total physical activity is discussed in increments of 100 cpm to ease the interpretation of the coefficient estimates. The value of the coefficient estimate is the amount of change in the dependent variable that is associated with a unit change in the PA independent variable, e.g., MVPA (1%) or total physical activity (100 cpm).

To assess the influence of energy intake on the relationship between change in PA and change in adiposity, energy intake was included in the regression models. If including energy intake changed the coefficient estimate of the PA variable by $> 10\%$, then it was considered a confounder (12, 14). Analyses were conducted using SPSS for windows (V16, SPSS Inc. Chicago, IL, USA) and SAS (v9.1, SAS Institute, Cary, NC). $P < 0.05$ denotes statistical significance.

RESULTS

Table 1 shows the participant characteristics at pre- and post-test. The participants consisted of 19 boys and 19 girls; 92% were Tanner stage 4 or 5. The participants were an average of 15 years, 95 kg, and 97th BMI %ile for age and gender at pre-test. There were statistically significant decreases between pre- and post-test in BMI z-score ($p=0.01$) and BMI percentile ($p=0.02$).

Although there were changes in PA or energy intake from pre-test to post-test, there were noteworthy individual changes in total physical activity (maximum decrease -317.8 cpm vs

maximum increase 339.3 cpm), percent of time spent in MVPA (maximum decrease -8.9% vs maximum increase 6.6%), and reported energy intake (maximum decrease was -1409 kcal vs maximum increase 2048 kcal). Figure 1 shows the individual values of change (post-pre) in total physical activity for each participant; 22 participants increased and 16 decreased their total physical activity. Similarly, 23 participants increased (mean $\pm$ SD, $2.8 \pm 2.1\%$) and 15 decreased ($-2.2 \pm 2.5\%$) their percent of time spent in MVPA. Table 2 shows the Pearson correlations of change in adiposity variables, change in physical activity variables, change in energy intake and demographic variables. Change in total physical activity and % time in MVPA were not correlated to change in adiposity. Age was the only variable significantly correlated with change in adiposity; older participants had greater reductions in fat mass and percent body fat ($p < 0.05$).

Changes in total physical activity and adiposity

Regression analyses revealed that an increase in total physical activity (cpm) was significantly associated with a decrease in total fat mass after controlling for the standard covariates ($B = -1.3$, $p = 0.02$). Including energy intake in the model increased the coefficient estimate 8% (Table 3; $B = -1.4$, $p = 0.02$), thus it cannot be concluded that energy intake confounded the relationship ($\geq 10\%$ change in estimate).

An increase in total physical activity (cpm) was significantly associated with a decrease in percent body fat ($B = -0.8$, $p = 0.03$), and energy intake confounded the relationship between total physical activity and percent body fat, increasing the coefficient estimate by 25% (Table 3; $B = -1.0$, $p = 0.01$). Figure 2 is a scatter plot of the change in total physical activity by the predicted values of change in total fat mass after controlling for the standard covariates, which shows a negative relationship between change in physical activity and predicted change in fat mass.

Changes in percent of time spent in moderate to vigorous physical activity and adiposity

After controlling for standard covariates, regression analyses revealed that an increase in percent time spent in MVPA was marginally associated with a decrease in percent body fat ($B = -0.26$, $p = 0.10$). When change in energy intake was included in the model, this relationship became significant (Table 4; $B = -0.33$, $p = 0.04$). The relationships between change in percent time in MVPA and percent body fat were no longer significant after accounting for change in total physical activity, regardless of whether change in energy intake was in the model ($B = -0.29$, $p = 0.43$) or not (Table 4; $B = 0.17$, $p = 0.64$).

Increases in percent of time spent in MVPA were associated with decreases in fat mass both before accounting for change in energy intake ($B = -0.49$, $p = 0.04$) and after ($B = -0.51$, $p = 0.03$), but not after controlling for change in total physical activity regardless of whether energy intake was excluded ($B = -0.02$, $p = 0.96$) or included in the model ($B = -0.15$, $p = 0.75$).

Parallel results were obtained when using MVPA cut-points generated by the Freedson pediatric equation (8, 9). Increases in MVPA were significantly associated with decreases in percent body fat ($B = -0.37$, $p = 0.09$) and fat mass ($B = -0.81$, $p = 0.009$) after accounting for energy intake, but not after adjusting for total physical activity (all $p > 0.60$). Including the total hours of measurement at pre- and post-test as covariates in the models did not impact the results and were not included in the final models.

DISCUSSION

A major objective of this study was to examine how changes in physical activity over a 16-week period are associated with changes in adiposity in overweight Hispanic adolescents.

The primary findings are that a short-term increase in objectively-measured total physical activity is significantly associated with a decrease in both total fat mass and percent body fat. Specifically, an increase of 28% of total physical activity, or 100 cpm, was associated with a decrease of 1.4 kg fat mass and 1% body fat after controlling for energy intake and standard covariates. To translate the accelerometry unit of counts per minute (cpm) into more physiologically relevant terms, prediction equations based on previous observations in normal weight adolescents (6) were used to estimate that an increase of 100 cpm is broadly similar to an increase of 250 kcal of energy expenditure.

A secondary objective was to examine energy intake as a confounder of the relationship between changes in physical activity and adiposity. Recent studies in adolescents state that adjusting for energy intake may strengthen the observed relationships between objectively-measured physical activity and adiposity (6, 35). The current study supports these assertions, finding that accounting for changes in energy intake strengthened the relationship between changes in physical activity and adiposity. Change in energy intake was identified as a confounder in the relationship between total physical activity and percent body fat, because adjusting for change in energy intake increased the coefficient estimate by 25%, which was greater than the 10% change in the coefficient needed to identify it as a confounder. Change in energy intake was not identified as a confounder in the relationship between total physical activity and total fat mass, because adjusting for change in energy intake only changed the coefficient estimate by 8%. The 10% change in coefficient to define a confounder is a rather arbitrary rule of thumb and is not based on a statistical test (14). Given that accounting for energy intake strengthened the relationship between changes in physical activity and adiposity, future studies attempting to quantify the magnitude of this relationship may consider whether to account for energy intake.

Accounting for the influence of energy intake had a modest effect on the relationship between physical activity and body fat. When the change in energy intake was accounted for, the decrease in fat mass that was associated with an increase of 100 cpm of total physical activity changed by 0.1 kg (1.3 kg to 1.4 kg), and the decrease in percent body fat changed by 0.2% (0.8% to 1.0%). The modest change observed when accounting for change in reported energy intake may be partly explained by the large variation in the change in energy intake from pre-test to post-test (from a decrease of -1409 kcal to an increase of 2048 kcal). This variation may be due to the self-report nature of the dietary measure. The variation could also be a reflection of a fasting/gorging cycle of eating that may be practiced by the adolescents in this sample. No studies describing the eating behaviors of overweight Hispanic adolescents were identified. Future studies that assess diet over a longer measurement period (7 to 14 days) may help to identify the dietary patterns of overweight Hispanic adolescents.

An increase in the percent of time spent in MVPA was not associated with a decrease in either percent body fat or total fat mass after accounting for total physical activity. These findings suggest that increases in total physical activity may be sufficient to result in improvements in body composition in overweight Hispanic adolescents. It should be noted that these findings do not suggest that increases in MVPA will not lead to reductions in fat mass, but MVPA may be difficult for and not well tolerated by this population. As such, it is important for future randomized trials to determine whether increases in total physical, independent of MVPA, can reduce adiposity in overweight Hispanic adolescents.

There is no clear consensus on whether the intensity level of physical activity influences changes in adiposity, especially in overweight adolescents. Some longitudinal studies that report a relationship between objectively-measured MVPA and body fat have accounted for total physical activity (6), while others have not (35). Therefore it remains unclear whether

the reductions in body fat observed in these studies were associated with MVPA independent of total physical activity. In a large cohort of 12-year olds, time spent in MVPA was negatively associated with fat mass after adjusting for total physical activity (22), suggesting that the physiological effects of MVPA may be importantly related to adiposity. Future longitudinal studies examining the relationship between MVPA and adiposity should control for total physical activity to determine whether decreases in adiposity are related specifically to an increase in MVPA or whether the effects are due simply to an increase in total physical activity. This has important public health implications given that the barriers to increasing MVPA may be different than the barriers to increasing total daily physical activity, especially in overweight youth (43).

It is also possible that a significant relationship between changes in percent of time spent in MVPA and adiposity was not detected because of the cut-points used to designate time spent in MVPA. There is no agreement on which cut-points should be used in different populations, and using cut-points derived from different prediction equations can yield markedly different results (13). The prediction equations, also, introduce residual error into the measurement, and thus counts per minute may be a more valid measure of activity than intensity level (8). It is unlikely, though, that the MVPA cut-point used in the current study contributed to the failure to detect a relationship between changes in MVPA and adiposity independent of total activity, because when cut-points from a different prediction equation were used to designate MVPA (8, 9), the results were replicated.

In a prospective four year study with older adolescents, Ekelund et al. (6) also reported that change in total activity, not MVPA, was related to change in adiposity, though they only reported these results in normal weight participants. The authors postulate that a failure to detect an association in overweight adolescents may be due to the lack of change in activity in this group. In the current study, we also reported a lack of overall change, but there was a nicely distributed variability in change in physical activity at the individual level. One reason for the apparently discrepant findings may be that the distribution of change in activity was differently dispersed in Ekelund et al., making it difficult to identify a relationship. It is difficult to compare results from these studies, though, due to differences in the populations studied, the length of the follow-up period, and the different covariates, such as dietary intake, included in the analyses.

Some longitudinal studies using body mass index to measure adiposity have failed to find a relationship with physical activity (35, 36). One strength of the current study was the ability to examine the relationship with objective measures of physical activity and adiposity, e.g., activity by accelerometry (29) and total fat mass and percent body fat measured by DEXA (10). Another strength of the current study is the homogeneity of the demographic characteristics (e.g., ethnicity, age, tanner stage, overweight status) of the sample of the participants. This homogeneity helps to reduce the effects of maturation bias, though this also restricts the generalizability of the findings to those who are similar to the study participants.

Our findings are supported by cross-sectional studies that have found a significant association between physical activity and adiposity (30, 33). Coupled with cross-sectional and longitudinal studies, the current analysis lends support to a causal inverse association between changes in physical activity and adiposity, but caution should be used when interpreting these findings as definitive evidence of causation.

A potential limitation to this study is the fact that accelerometry is not a perfect measure of physical activity, because it is worn on the hip and does not accurately detect bicycling or upper body movement, such as weight lifting. Similarly, the accelerometer cannot be worn

during water-based activities, such as swimming. A recent large cohort study reported that swimming is not a common activity among Hispanic adolescents (1), so this limitation may not be of concern in the current sample. The definition of valid accelerometry data used in the current study, 2 days and 6 hours, is another potential limitation, though the average measurement period was approximately 70 hours. The self-report nature of the dietary data may also be a limitation, especially given the overweight status of the sample and the likelihood of overweight participants to underreport their dietary intake (25). Another possible limitation of the study is the fact that dietary intake was not examined as either an effect modifier or a mediator of the relationship between physical activity and adiposity. The authors acknowledge the probability that energy intake may act as a mediator and/or effect modifier, but that investigation is outside the scope of the current study.

To our knowledge, this is the first study to examine the relationship between short-term changes in objectively-measured activity by accelerometry and adiposity and to examine the influence of energy intake on this relationship in overweight Hispanic adolescents. In summary, after accounting for changes in energy intake an increase of 28% of total physical, or roughly 250 kcal, was associated with a modest, yet significant, decrease in 1.4 kg of fat mass and 1% percent body fat in overweight Hispanic adolescents over 16-weeks, while there was no association between change in time spent in MVPA and adiposity independent of total physical activity.

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Figure 1.
Change in total physical activity (counts per minute) by individual (n=38).

Figure 2. Change in total physical activity (cpm) by change in fat mass (kg). Predicted values are adjusted for sex, age, intervention group, lean tissue mass, and pre-test physical activity (n=38).

Table 1

Characteristics of overweight Latino participants at pre-test and post-test (n=38)[†]

	Pre-test	Post-test
Demographic Factors		
Sex (% male)	50.00%	--
Age (yrs)	15.3(1.0)	15.8(0.98)
Maturation/Tanner stage (1–5), median(SD)	5.0(0.8)	--
Body composition variables		
Weight (kg) [±]	93.9(23.3)	93.8(21.9)
Total fat (kg)	35.9(15.1)	34.7(12.8)
Lean tissue (kg)	55.8(10.9)	56.4(11.6)
Body fat (%)	37.9(8.0)	36.9(7.4)
BMI z-score [±]	2.1(0.6)	2.0(0.6) ^{**}
BMI %ile for age and gender [±]	96.8(3.9)	95.9(5.6) [*]
Physical activity variables		
Total physical activity (cpm)	359.9(124.8)	380.1(141.5)
Percent of time in MVPA [‡]	4.9(2.9)	5.7(3.4)
Energy intake (kcal)	1908.2(681.1)	1762.3(741.5)

NOTE: Values are mean(SD) unless otherwise specified. Height and weight are an average of three measurements, energy intake assessed with 3-day diet records, and physical activity assessed with 7-day accelerometry.

[±] BMI, body mass index.

[‡] %MVPA, moderate-to-vigorous physical activity. Statistical test was paired t-test,

^{*} p<0.05,

^{**} p<0.01.

Pearson correlations of change in adiposity variables, change in physical activity variables, change in energy intake and demographic variables (n=38)

Table 2

	Change in adiposity	
	Change in fat mass (kg) correlation coefficient (p-value)	Change in percent body fat correlation coefficient (p-value)
Change in total PA (cpm)	-0.23 (0.17)	-0.29 (0.08)
Change in % time in MVPA	-0.19 (0.25)	-0.22 (0.19)
Change in energy intake (kcal)	0.13(0.44)	0.05 (0.76)
Age (yrs)	-0.42(0.01)	-0.37 (0.02)
Sex (1=male)	0.30 (0.06)	0.15 (0.38)

NOTE: PA, physical activity; cpm, counts per minute; MVPA, moderate to vigorous physical activity;

Table 3

Regression analyses of changes in total physical activity (cnts/min) and changes in total fat mass and % body fat (n=38)

Predictor Variables	Dependent Variables	
	Change in total fat mass (kg)	Change in % body fat
Intercept	30.12 (11.3)*	24.90 (8.2)88
Demographic factors		
Sex	3.87 (1.8)*	2.74 (0.9)**
Age (yrs)	-2.07 (0.6)**	-1.62 (0.5)**
Body composition		
Adiposity measure at visit 1 (kg, %)	0.87 (0.1)***	0.85 (0.1)***
Lean tissue mass at visit 1 (kg)	-0.23 (0.2)	--
Lean tissue mass at visit 2 (kg)	0.21 (0.2)	--
Intervention assignment		
Nutrition + strength training group	-0.94 (1.4)	-0.12 (1.0)
Nutrition only group	-3.31 (1.7)	-2.58 (1.3)
Physical activity variables		
Mean total PA at visit 1 (cpm)	0.005 (0.006)	0.003 (0.004)
Change in mean total PA (cpm)	-0.014 (0.005)*	-0.01 (0.004)*
Change in energy intake (kcal)	0.001 (0.001)	-0.001 (0.001)

NOTE: PA, physical activity; cpm, counts per minute. Values are unstandardized coefficient estimates (SE).

* p<0.05,

** p<0.01,

p<0.001. Multiple regression analyses were conducted to assess whether changes in mean total PA were associated with changes in total fat mass and % body fat after controlling for covariates.

Table 4

Regression analyses of changes in percentage of time spent in moderate to vigorous physical activity (MVPA) and changes in % body fat with and without controlling for total PA (counts/min; n=38)

Predictor Variables	Dependent Variable = Change in % body fat	
	Model without controlling for total PA (cpm)	Model controlling for total PA (cpm)
Intercept	23.56 (8.2) **	24.60 (7.9) **
Demographic factors		
Sex	2.7 (0.9) **	2.7 (0.9) **
Age (yrs)	-1.5 (0.5) **	-1.6 (0.5) **
Body composition		
% body fat at visit 1	0.85 (0.1) ***	0.87 (0.8) ***
Intervention assignment		
Nutrition + strength training group	-0.21 (1.1)	-0.21 (1.1)
Nutrition only group	-2.9 (1.3) *	-2.6 (1.3) †
Physical activity variables		
% time in MVPA at visit 1	16.6 (20.6)	16.6 (20.1)
Change in % time in MVPA	-0.33 (0.15) †	0.17 (0.40)
Change in mean total PA (cnts/min)	--	-0.01 (0.01)
Change in energy intake (kcal)	-0.001 (0.001) †	-0.001 (0.001) †

NOTE: MVPA, moderate to vigorous physical activity; PA, physical activity. Values are unstandardized coefficient estimates (SE).

† p < 0.10,

* p < 0.05,

** p < 0.01,

*** p < 0.001. Multiple regression analyses were conducted to assess whether changes in % time in MVPA were associated with changes in % body fat after controlling for covariates.