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The Relationship Between Physical Activity and the Metabolic Syndrome Score in Children

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Abstract

The relationship between physical activity levels and the metabolic syndrome (MetSyn) score was examined in 72 boys and girls (9.5 ± 1.2 years). A fasting blood draw was obtained; waist circumference and blood pressure measured, and an accelerometer was worn for 5 days. Established cut points were used to estimate time spent in moderate, vigorous, moderate-to-vigorous (MVPA), and total physical activity. A continuous MetSyn score was created from blood pressure, waist circumference, high-density-lipoprotein, triglyceride, and glucose values. Regression analysis was used to examine the relationship between physical activity levels, the MetSyn score, and its related components. Logistic regression was used to examine the association between meeting physical activity recommendations, the MetSyn score, and its related components. All analyses were controlled for body mass index group, age, sex, and race. Time spent in different physical activity levels or meeting physical activity recommendations (OR: 0.87, 95%CI: 0.69-1.09) was not related with the MetSyn score after controlling for potential confounders ($p>0.05$). Moderate physical activity, MVPA, and meeting physical activity recommendations were related to a lower diastolic blood pressure ($p<0.05$). No other relationships were observed ($p>0.05$). While physical activity participation was not related with the MetSyn, lower diastolic blood pressure values were related to higher physical activity levels.

Keywords

cardiovascular disease risk factors; exercise; pediatrics; obesity

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Introduction

The Metabolic Syndrome (MetSyn) is a clustering of specific cardiovascular risk factors, such as hypertension, dyslipidemia, glucose intolerance, and adiposity (17). In the United States, the MetSyn has been reported to be present in adults (34.3%), adolescents (8.6%), and children (5%) (9, 19, 25). Obese youth have a higher prevalence of the MetSyn compared to non-obese counter parts (7). Obesity may be a primary factor for MetSyn development in youth (22). According to longitudinal data, the risk for the MetSyn as an adult increases significantly if the MetSyn and its components are present during childhood (4, 32), indicating this is a time where the stage is being set for a number of adverse health outcomes in adulthood (26).

One of the challenges studying the MetSyn in either children or adolescents is the lack of a standard definition (18, 21). An additional challenge is the low prevalence of the MetSyn in this population (i.e., <10%). As a result, it has been suggested that creation of a continuous variable (the MetSyn score) which comprises the components of the MetSyn is more advantageous than a dichotomous MetSyn variable (13, 27). A higher MetSyn score represents a less favorable metabolic profile.

Among adults, participating in physical activity reduces the risk for many chronic diseases. Physical activity has also been negatively associated with the MetSyn in adults and adolescents (5, 6, 9, 34, 35). Total physical activity participation appears to be related to the MetSyn in children (2, 3, 14, 15). Brague et al. (3) reported that the MetSyn score was inversely related to total physical activity in Danish children (mean age = 9.6 ± 0.44 years). Others have also found an inverse relationship between total physical activity and the MetSyn score in European children and adolescents (2, 14, 15).

In contrast, the evidence regarding the relationship between different physical activity intensities and the MetSyn score in children is limited and not consistent. Martinez-Gómez et al. (31) found no relationship between moderate physical activity, vigorous physical activity, or moderate-to-vigorous physical activity (MVPA), and the MetSyn score in adolescents. Conversely, light-, moderate-, and vigorous-intensity physical activity have been negatively related to the MetSyn score in children and adolescents (14). Recently, Jiménez-Pavón et al.(24) showed the odds of having a high MetSyn score was higher for boys (6-9 year olds: OR=3.26, 95% CI: 1.74-6.10) in the lowest physical activity quintile compared to those in the highest physical activity quintile; however, this relationship was not observed among girls.

These studies suggest a negative relationship between physical activity intensity and the MetSyn score; however, given the limited amount of research it is unclear what the effect of participating in moderate- or vigorous-intensity physical activity, MVPA, or meeting physical activity recommendations has on the MetSyn score. It is also unknown if the relationship is different for children compared to adolescents, as both age groups have previously been used as participants (14, 15). Marked declines in moderate and vigorous physical activity have been reported during adolescence (11, 38). Thus, it is important to examine children separately from adolescents. Therefore, the purpose of this study was to examine the relationships between various physical activity intensities (moderate-intensity physical activity, vigorous-intensity physical activity, MVPA), total physical activity, meeting physical activity recommendations and the MetSyn score, as well as individual components of the MetSyn, in children.

Methods

Participant Selection

Participants were recruited via local after-school programs, churches, elementary schools, and newspaper advertisements. Inclusion into the study included: 1) boys and girls between 7 to 11 years old, and 2) free from neuromuscular or physiologic disease that impaired physical activity participation. Children could not participate if they had any of the following conditions: 1) known cardiovascular disease, or 2) diabetes (Type 1 or Type 2). The parent and child provided written consent and assent, respectively, in accordance with the university's Institutional Review Board.

Study Design

For this cross-sectional study, the following procedures were completed: 1) sexual maturity, 2) anthropometrics, 3) resting blood pressure, 3) fasting blood draw, and 4) physical activity measurement.

Measures

Sexual Maturity—Sexual maturity was determined by Tanner staging via parent proxy. Parents of the participants viewed sketches of stages of sexual maturation, identified their child's personal development, and then placed the sheets in an envelope and sealed them before returning them to the investigator. This method is as valid as Tanner staging by a physician without the increased burden placed on the child (33).

Anthropometric Data—Height was measured to the nearest 0.1 centimeter using a wall mounted stadiometer (Perspective Enterprises, Portage, MI, USA). Weight was measured to the nearest 0.1 kilogram using a portable electronic scale (model # 68987, Befour Inc., Saukville, WI, USA). Both height and weight were measured in duplicate with shoes off, but wearing light weight clothing. Age and gender adjusted body mass index (BMI) was calculated as kg/m^2 according to the Centers for Disease Control guidelines (28). BMI percentiles were calculated and then grouped into the following categories: healthy weight (BMI <85th percentile), overweight (BMI ≥ 85th percentile, but <95th percentile), and obese (≥95th percentile) (28). Waist circumference measurements were taken at the narrowest portion of the waist underneath clothing using a Gulick tape measure (1). Waist circumference was measured in duplicate to the nearest 0.1 mm and the average value was calculated.

Blood Pressure—Resting blood pressure was obtained on two different study visits. The child rested quietly for five minutes before blood pressure was measured in duplicate by trained personnel using a random-zero sphygmomanometer. The first and last Korotkoff sounds were recorded as systolic and diastolic blood pressure, respectively (1). The duplicate systolic and diastolic measurements were used to calculate the average systolic and diastolic blood pressure. These average values were then used to calculate mean arterial pressure (MAP) using the following formula: MAP = ((systolic blood pressure-diastolic blood pressure)/3) + diastolic blood pressure. The presence of hypertension (≥95th percentile for height, age, and sex) was also calculated.

Blood Collection and Analyses—Blood samples were obtained after an 8 hour fast using standard venipuncture methods by a trained phlebotomist. Glucose, total cholesterol, and triglyceride concentrations were measured enzymatically using a Cobas Mira Chemistry System (Roche Diagnostic Systems, Indianapolis, IN, USA). High-density-lipoprotein cholesterol (HDL-C) concentrations were also measured enzymatically using a Cobas Mira Chemistry System (Diagnostic Chemicals Ltd, Oxford, CT, USA). Low-density-lipoprotein cholesterol was estimated by Friedewald's formula (20).

Metabolic Syndrome Score—A continuous metabolic syndrome score was created from the following factors: waist circumference, HDL-C, triglycerides, glucose, and MAP. These factors were chosen because they comprise the Metabolic Syndrome in adults, and factor analyses have shown that lipids, glucose, blood pressure, and adiposity are important for cardiovascular risk in the pediatric population (22, 23, 29). The standardized residuals (z-score) was calculated for each component and then the standardized score for HDL-C was multiple by -1 since it is inversely related to metabolic risk. The z-scores for waist circumference, glucose, triglyceride, HDL-C and MAP were then summed together to generate the MetSyn score.

Physical Activity Assessment—Children wore an ActiGraph accelerometer (GT1M, ActiGraph LLC, Pensacola, FL, USA) for five consecutive days, including two weekend days. The accelerometer was worn during waking hours around the waist. To increase compliance, the children called the lab each morning and indicated they were wearing the accelerometer. Study staff followed-up with children who did not call the lab each day.

Physical Activity Data Reduction—The epoch length was set at 1 minute intervals. Data were included if the accelerometer was worn for at least 4 days, included at least one weekend day, and 10 hours per day. Amount of time spend in moderate and vigorous physical activity were determined using Freedson's cut points (39). Light physical activity was classified as being between >1.0 and 3.9 METs, moderate physical activity was between 4-6.9 METs and vigorous physical activity was ≥ 7 METs. Total physical activity was calculated as the sum of light, moderate and vigorous physical activity. MVPA was defined as activities ≥ 4 METs. Participants were classified as meeting physical activity recommendations if they averaged ≥ 60 minutes of MVPA per day over the measurement period (40).

Statistical analysis

Means and standard deviations were calculated for demographic characteristics and student's t-test was used to examine differences in demographic characteristics of those meeting and not meeting physical activity recommendations. Chi-square analysis was used to determine differences in meeting physical activity recommendations between BMI group (i.e., healthy weight and overweight/obese), race, and sex. Regression analysis was used to examine the relationships between average amount of time spent in moderate and vigorous physical activity per day, MVPA per day, total physical activity per day, counts per minutes, the MetSyn score, and its components adjusted for age, sex, and race. Logistic regression analysis was used to explore the relationships between meeting physical activity recommendations, the MetSyn score, and its components adjusted for age, sex, and race. SAS (version 9.3, Research Triangle, NC, USA) was used for all analysis. The significance level was set at $p < 0.05$.

Results

Participant Characteristics

One hundred twenty-four children completed the study; however, 52 children's data were not used in the analyses due to incomplete data for: physical activity (n=39), blood pressure (n=1), waist circumference (n=7), and lipids/glucose (n=5). The majority of the children were Caucasian (60%), females (61%), and pre-pubescent (74%). Regarding BMI classification, 39% had a healthy weight, 16% were overweight, and 45% were obese. Seventy-eight percent of the participants had normal blood pressure values (< 90^{th} percentile), 12% were pre-hypertensive (≥ 90^{th} percentile but < the 95^{th} percentile), and 10% were hypertensive (≥ 95^{th} percentile). Overall the children had normal lipid and glucose values (Table 1).

Physical Activity

Children wore the accelerometer on average for 12 hours per day, and engaged in over 60 minutes per day of moderate physical activity, but less than 10 minutes per day of vigorous physical activity (Table 1). Compared to girls, boys participated in more moderate physical activity (boys: 79.7 ± 48.9 min/day, girls: 59.1 ± 32.0 min/day; $p<.05$) and MVPA (boys: 86.9± 54.6 min/day, girls: 63.9 ± 34.0 min/day; $p=.03$); however, time spent in vigorous physical activity was similar (boys: 7.2 ± 7.1 min/day; girls: 4.8 ± 6.2 min/day; $p>.05$). While Caucasians spent more time in vigorous physical activity than non-Caucasians ($p=.001$), no other racial differences in physical activity were observed. Further, physical activity levels (any intensity) were similar by BMI classification ($p>.05$).

Physical Activity Recommendations

Half of the children met physical activity recommendations. Those who met physical activity recommendations were primarily Caucasians (56%), boys (57%), and healthy weight (66%), ($p<0.05$). Wear time for the accelerometer was similar between those who met and did not meet physical activity recommendations (Table 1). Children meeting physical activity recommendations weighed less, had a lower BMI, waist circumference, diastolic blood pressure, and MetSyn score, and participated in more minutes of moderate, vigorous, and total physical activity compared to those who did not met physical activity recommendations (Table 1).

Unadjusted Analyses

Table 2 shows the univariate analysis between moderate, vigorous, total physical activity, the MetSyn score and MetSyn components. None of the physical activity variables were significantly correlated with either the MetSyn score or its components. The MetSyn score did significantly correlate with its related components. HDL-cholesterol was moderately and inversely correlated with triglycerides, waist circumference, and MAP. A moderately positive association was observed between waist circumference, triglycerides, and MAP.

Adjusted Analyses

Time spent in moderate, vigorous, and total physical activity, and MVPA were not related to the MetSyn score, HDL, triglyceride levels, glucose, or waist circumference after adjusting for confounders (Table 3). Moderate and total physical activity was negatively related to diastolic blood pressure; no other relationships existed between both moderate or total physical activity and individual MetSyn components. No relationships were observed between vigorous physical activity, counts per minute and either the MetSyn score or its related components. Time spent in MVPA was negatively related to diastolic blood pressure, but no other relationships were observed (Table 3). Meeting physical activity recommendations was negatively related to the MetSyn score (OR: 0.81, 95%CI: 0.66 - 0.98) and diastolic blood pressure (OR: 0.91, 95%CI: 0.84 - 0.98) adjusting for age, race and sex. No other relationships were observed. Because more healthy weight children met physical activity recommendations than overweight/obese children, the analyses were also controlled for BMI group (healthy weight or overweight/obese) in addition to age, race, and sex. This analysis indicated that meeting physical activity recommendations was no longer related to the MetSyn score (OR: 0.87, 95%CI: 0.69 – 1.09); however, meeting physical activity recommendations was still negatively related to diastolic blood pressure (OR: 0.92, 95%CI: 0.85 - 0.99).

Discussion

This study examined the relationships of different physical activity intensities with the MetSyn score and its components. The association between meeting physical activity guidelines and the MetSyn score and its components was also explored. The main findings indicated that the MetSyn score was not related to physical activity participation, regardless of the intensity, or meeting physical activity recommendations. Likewise, the majority of the MetSyn components were not related with participation in physical activity, except lower diastolic blood pressure was associated with more time spent in moderate and total physical activity and MVPA. Further, children who met current physical activity recommendations were more likely to have a lower diastolic blood pressure than those not meeting current recommendations.

The lack of a relationship between moderate and vigorous physical activity, MVPA, and the MetSyn score is similar to the findings presented by Martinez-Gómez et al. (31). They reported that regardless of the physical activity intensity (moderate, vigorous, or MVPA) there was no relationship with the MetSyn score in 13-17 year olds. In contrast, Ekelund et al. (14) reported that moderate and vigorous physical activities were inversely related with the MetSyn score in 9 and 15 year olds. Moreover, Jiménez-Pavón et al.(24) reported the odds of having the MetSyn score were higher for boys and girls in the lowest quartile of moderate physical activity (OR: 2.58 to 3.85, respectively), vigorous physical activity (OR: 2.49 to 3.82, respectively), and MVPA (OR: 1.55 to 3.77, respectively) compared to the highest quartile. One possible explanation for why the current study results differed from others could be the sample size. Many of the studies measured over 1,000 children; in contrast the current study only measured 72 children. Further, it is possible that in children all activity, regardless of intensity may be beneficial for influencing the MetSyn score. To illustrate this point, Ekelund et al. (14) found that total physical activity had a stronger relationship with the MetSyn score than either moderate or vigorous physical activity. Yet another possibility is that, the amount of time spent in vigorous physical activity is important. The amount of vigorous physical activity was higher in previous studies compared to the current study. Further, Martinez-Gómez et al. (31) reported an interaction between vigorous physical activity, cardiorespiratory fitness, and the MetSyn score, where those with high physical activity and fitness levels had a lower MetSyn score than those with low physical activity and fitness levels. Therefore, the amount of vigorous physical activity may be important for impacting the MetSyn score (31).

Total physical activity participation and counts per minute were not related with either the MetSyn score or individual components of the MetSyn. These results are in contrast with what others have reported (2, 3, 14, 15). In previous studies, the amount of total physical activity (defined as counts per minute) the children and adolescents participated in was much higher than the amount reported in the current study. There may be a threshold of total physical activity that is necessary to impact the MetSyn score; however, this idea needs further evaluation.

Detecting an inverse relationship between meeting physical activity recommendations and the MetSyn score was a novel finding; however, BMI group attenuated this relationship. One explication for BMI attenuating the relationship is that the relationship between BMI and the MetSyn score is stronger ($r=0.67$; $p<0.0001$) than the relationships between the MetSyn score and any of the physical activity variables ($r= -0.18$ to 0.063; $p>0.05$). The MetSyn score has been reported to be positively related with BMI (9, 30). Previous research has shown that adjusting for a marker of obesity - waist circumference - did not impact the relationships found between either MVPA and the MetSyn components (16) or total PA (counts per minute) and the MetSyn score (14). While no relationship was observed in this study, the odds ratio was going in the expected direction; meeting physical activity recommendations lowering the odds of a high MetSyn score. Given a larger proportion of healthy weight children met PA recommendations than overweight/obese children, weight status may have moderated the impact meeting physical activity recommendations has on the MetSyn score. Unfortunately, the sample size was not large enough to examine this relationship among healthy weight and overweight/obese children separately. Others have suggested that 60 minutes or more of daily MVPA are needed to promote good metabolic health in youth (2, 24). Further investigation regarding the impact meeting physical activity recommendations have on metabolic health in overweight/obese children is needed.

In the present study, the only MetSyn component related to physical activity (moderate physical activity and MVPA) was diastolic blood pressure. This finding supports and contradicts previous research. Andersen et al. (2) reported that diastolic blood pressure was inversely related with total physical activity; however, so were waist circumference, systolic blood pressure, glucose, and triglycerides, while HDL was positively related with total physical activity. Ekelund et al. (14, 15) also reported that diastolic blood pressure was negatively related with time spent in moderate physical activity, but no relationship existed between moderate or vigorous physical activity and HDL and waist circumference. In contrast, they did report physical activity was negatively associated with systolic blood pressure, glucose, and triglyceride concentrations. These results were observed for total, moderate, and vigorous physical activity (14, 15). One possible reason for the difference in the results between the current and previous studies could be due to activity level. In the current study, children spent 67 minutes per day in moderate physical activity and 5 minutes per day in vigorous physical activity. This amount is lower than what has been in European data, especially for vigorous physical activity (3, 14, 15). Participation in vigorous physical activity may play an important role impacting the factors of the MetSyn. Given the limited and conflicting results regarding physical activity and components of the MetSyn (2, 14, 15), reaching a conclusion concerning the relationship physical activity has with MetSyn components is challenging. It appears that physical activity is related to improved diastolic blood pressure in children; however, the effect physical activity has on the other components needs further evaluation.

Some limitations exist within this study. The physical activity levels reported are probably under-estimated due to two factors. First, while accelerometers are good objective measures of physical activity levels in children (37, 41), they cannot measure activities such as, swimming and riding a bicycle. Some children did report participating in these activities while wearing the accelerometer. Second, the epoch setting was set at 1 minute. Research has shown shorter epochs captures more time spent in moderate and vigorous physical activity in children given their sporadic nature of movement (8, 12). Although, other research suggests that a shorter epoch may not be necessary when physical activity is examined in relation to a physiologic outcome (36). Therefore, the epoch setting may have limited impact on the overall findings. Third, the children had low levels of physical activity, especially vigorous physical activity. This low amount of time in physical activity could make it difficult to detect relationships even if they exist. In addition, on average the sample was metabolically healthy; making it difficult to detect a relationship with physical activity if one exists. Finally, due to the cross-sectional design causality cannot be determined.

In spite of the limitations, this study has strengths. Physical activity was measured objectively. In a younger population, self-report physical activity measures maybe inaccurate due to poor concept of time and the intermittent nature of physical activity patterns. Further, 61% of the sample was either overweight (16%) or obese (45%); obese participants have been underrepresented in similar studies (3, 14, 15, 24). The study examined not only the contributions of different physical activities intensities, but also meeting physical activity recommendations. Finally, using a continuous MetSyn score allowed for increased statistical power. A continuous MetSyn score is also a more robust measure of the MetSyn, than a dichotomous variable, because CVD risk is a progressive function of the MetSyn components.

In conclusion, physical activity is important for children's health; unfortunately many children are not meeting recommended physical activity levels. The results from this study suggest that physical activity levels (total and different intensities) are not related to the MetSyn score. In contrast physical activity participation and meeting physical activity recommendations were inversely related to diastolic blood pressure. The contributions that moderate and vigorous physical activities have on the MetSyn score and its components are yet to be fully understood. Further, research is needed to better understand the effect different physical activity intensities have on the MetSyn and its related components in youth.

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Table 1

Demographics of the Participants for the Total Sample and Grouped by Meeting or Not Meeting Physical Activity Recommendations.

Variable	Meeting PA Recommendations: Yes n = 36 (Mean ± SD)	Meeting PA Recommendations: No n= 36 (Mean ± SD)	All N=72 Mean ± SD)
Age (years)	9.4 ±1.3	9.6 ± 1.2	9.5 ± 1.2
Weight (kg)	42.9 ± 13.7*	51.4 ± 16.0	46.9 ± 15.3
Height (cm)	143.5 ± 8.2	145.7 ± 10.4	144.6 ± 9.3
Body mass index (kg/m^2)	20.5 ± 5.0*	23.7 ± 5.9	22.1 ± 5.7
Waist circumference (cm)	69.0 ± 10.6*	74.5 ± 12.4	71.7 ± 11.8
Systolic blood pressure (mmHg)	103.8 ± 8.3	103.5 ± 11.3	103.7 ± 9.9
Diastolic blood pressure (mmHg)	64.5 ± 8.0*	69.1 ± 7.6	66.8 ± 8.1
Mean arterial pressure	77.6 ± 6.7	80.5 ± 7.9	79.1 ± 7.5
Cholesterol (mg/dL)	161.7 ± 30.2	165.7 ± 20.1	163.7 ± 25.5
LDL (mg/dL)	94.8 ± 25.1	102.0 ± 20.9	98.4 ± 23.2
VLDL (mg/dL)	13.6 ± 13.8	15.1 ± 7.7	14.4 ± 11.1
HDL (mg/dL)	53.1 ± 11.2	48.9 ± 11.4	51.0 ± 11.4
Triglycerides (mg/dL)	68.1 ± 68.9	75.4 ± 38.5	71.7 ± 55.7
Glucose (mg/dL)	88.1 ± 9.9	89.5 ± 6.6	88.8 ± 8.4
MetSyn score	-0.69 ± 2.9*	0.85 ± 3.1	0.07 ± 3.1
Moderate PA (min/day)	97.3 ± 36.1*	36.9 ± 11.7	67.1 ± 40.5
Vigorous PA (min/day)	8.9 ± 7.8*	2.5 ± 2.7	5.7 ± 6.6
MVPA (min/day)	106.2 ± 39.1*	39.4 ± 12.6	72.8 ± 44.3
Total PA (min/day)	567.9 ± 199.5*	255.8 ± 100.4	411.85 ± 221.9
Total Counts (per minute)	594.4 ± 169.8*	436.1 ± 97.5	515.05 ± 158.8
Wear time (min/day)	773.8 ± 87.3	741.2 ± 142.7	757.48 ± 118.6

LDL = low-density-lipoprotein cholesterol; VLDL = very low-density-lipoprotein cholesterol; HDL = high-density-lipoprotein cholesterol; MetSyn score= z-score for metabolic syndrome; PA = physical activity; MVPA=moderate-to-vigorous physical activity;

* = $p<0.05$.

Table 2

Correlation Between Physical Activity, MetSyn Score, and its Components.

Variable	Moderate	Vigorous	MVPA	Total	Counts	MetSyn	HDL	Glucose	Trig	Waist	MAP
Moderate	1.0										
Vigorous	.53*	1.0									
MVPA	0.99*	0.63*	1.0								
Total	0.79*	0.29*	0.77*	1.0	1.0						
MetSyn	-.18	-.01	-.16	-0.15	0.62	1.0					
HDL	.21	-.15	.17	0.13	-0.11	-.64*	1.0				
Glucose	.05	-.03	.04	0.02	-0.02	.39*	.10	1.0			
Trig	-.05	.11	-.03	-0.3	0.16	.68*	-.48*	.06	1.0		
Waist	-.14	-.21	-.15	-0.15	-0.08	.72*	-.26*	.22	.34*	1.0	
MAP	-.19	-.11	-0.19	-0.19	-0.07	.56*	-.23*	-.05	.14	.35*	1.0

MVPA = moderate-to-vigorous physical activity; Counts = counts per minute; MetSyn = z-score for metabolic syndrome; HDL = high-density-lipoprotein cholesterol; Trig = triglycerides; waist = waist circumference; MAP = mean arterial pressure;

* = $p<0.05$

Table 3

Relationship between Minutes Spent in Moderate, Vigorous, MVPA, Meeting PA Recommendations, the MetSyn Score, and its Components Adjusting for Age, Sex, and Race.

Variable	Moderate β (SE)	Vigorous β (SE)	MVPA β (SE)	Total β (SE)	Counts/min β (SE)	Meeting PA Rec β (SE)
MetSyn	-0.014 (0.009)	0.0013 (0.06)	-0.012 (0.008)	-0.0017 (0.002)	0.00078 (0.003)	-0.207 (0.099)*
HLD	0.057 (0.034)	-0.276 (0.213)	0.042 (0.032)	0.007 (0.006)	-0.0085 (0.009)	-0.036 (0.233)
Waist	-0.039 (0.035)	-0.333 (0.224)	-0.399 (0.032)	-0.005 (0.006)	-0.0074 (0.009)	-0.043 (0.025)
Triglycerides	-0.175 (0.174)	0.417 (1.069)	-0.138 (0.160)	-0.0138 (0.031)	0.0294 (0.046)	-0.0045 (0.004)
Glucose	0.012 (0.024)	0.003 (0.149)	0.010 (0.022)	0.002 (0.004)	-0.0033 (0.006)	-0.012 (0.34)
MAP	-0.029 (0.022)	-0.076 (0.137)	-0.027 (0.020)	-0.007 (0.004)	0.0011 (0.006)	-0.067 (0.039)
Systolic BP	0.018 (0.029)	-0.213 (0.179)	0.010 (0.027)	0.006 (0.005)	-0.0026 (0.008)	0.0034(0.026)
Diastolic BP	-0.054 (0.024)*	-0.008 (0.151)	-0.045 (0.21)*	-0.013 (0.004)*	0.0030 (0.006)	-0.09 (0.038)*

MVPA = moderate-to-vigorous physical activity; PA Rec = physical activity recommendations; MetSyn score= z-score for metabolic syndrome; HDL = high-density-lipoprotein cholesterol; MAP = mean arterial pressure;

* = $p<0.05$