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Accelerometer-Measured Physical Activity in Chinese Adults

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Abstract

Background—Following adoption of a Western lifestyle, China is experiencing a decline in physical activity levels, which is projected to contribute to future increases in the burden of chronic diseases.

Purpose—To target public health interventions and identify personal characteristics associated with physical activity and sedentary behavior in urban Chinese adults.

Methods—In 576 men and women aged 40–74 years from Shanghai, multiple logistic regression were used to examine demographic, anthropometric, and lifestyle factors in relation to levels of physical activity and sedentary behavior assessed by Actigraph accelerometers.

Results—Participants spent 317 min/day in physical activity and 509 min/day sedentary. In multivariate models, people aged ≥ 60 years were significantly less likely than those aged < 50 years to engage in physical activity (OR=0.29; 95% CI=0.17,0.49) and more likely to spend time sedentary (OR=2.77, 95% CI=1.53,5.05). Similarly, obese individuals were less likely to be physically active (OR=0.34, 95% CI=0.17,0.66) and they were suggestively more likely to be sedentary (OR=1.87, 95% CI=0.94,3.71) than normal weight individuals. Furthermore, current cigarette smokers were less physically active than those who formerly or never smoked (OR=0.47, 95% CI=0.28,0.78).

Conclusions—Physical activity promotion programs in urban China should target older people, obese individuals, and cigarette smokers, as these population subgroups exhibited low levels of physical activity.

INTRODUCTION

Most of the evidence that an inactive lifestyle is linked to increased risk of morbidity and mortality derives from Western populations. Recently, similar associations have been observed

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in transition countries, including China.^{1–5} It has been proposed that with adoption of a Western lifestyle, a decline in physical activity levels will contribute to a substantial future increase in the burden of chronic diseases in China.^{6–8}

An understanding of the demographic, anthropometric, and lifestyle characteristics that are correlated with physical activity in China would be of great utility for health promotion efforts that aim to modify physical activity levels. The accumulated evidence regarding characteristics associated with physical activity reveals that older individuals, women, people who are overweight or obese, and cigarette smokers are among those less likely to engage in a high level of activity.⁹ However, few reports of the correlates of physical activity are based on populations in developing countries, and whether these same factors are related to physical activity in Chinese populations is uncertain. Two previous investigations in Shanghai^{10,11} found that older age was positively associated with self-reported daily physical activity in men¹¹ and with exercise in women,¹⁰ and high BMI was positively related to exercise in men¹¹ and to daily activity in women,¹⁰ indicating that the correlates of physical activity in China may differ from those in Western populations.

Yet existing knowledge of the epidemiology of physical activity in China derives primarily from self-reported physical activity assessed via questionnaires. Physical activity is a complex behavior, difficult to assess accurately by self-report methods due to misreporting and cognitive issues of recall.^{12,13} Objective physical activity monitors such as accelerometers circumvent these limitations to provide unbiased assessment of most ambulatory behaviors. Although limited in the ability to measure all physical activities (e.g., swimming or cycling), accelerometry is a valid method for measuring physical activity in epidemiologic studies,^{14, 15} and can provide an important complement to studies based on self-report for understanding the prevalence and potential correlates of physical activity. Therefore, the relationship of demographic, anthropometric, and lifestyle factors were examined with accelerometer-measured physical activity and sedentary behavior in order to gain an understanding of factors related to physical activity and inactivity among adults in urban China.

METHODS

The Shanghai Cohort Studies

The Shanghai Women's Health Study (SWHS) and Shanghai Men's Health Study (SMHS) are population-based prospective cohort studies of 74,943 women (aged 40–70 years at baseline) and 61,582 men (aged 40–75 years at baseline). Study participants were permanently residing in one of seven (SWHS) or eight (SMHS) communities in Shanghai, China, and were recruited to the studies between 1997 and 2006 (1997–2000 for the SWHS and 2001–2006 for the SMHS).

Shanghai Physical Activity Study

The Shanghai Physical Activity Study was conducted in a randomly selected subset of participants from 2 communities of the SWHS and the SMHS. Participant enrollment began in December 2005, and data collection was completed in September 2008. Of 1,101 people contacted, 619 agreed to participate (56%).

Participants were enrolled in the study for 1 year, during which they were asked to wear an Actigraph accelerometer for 7 consecutive days, four times during the study (i.e., at baseline [Month 1], and in Months 4–5, Months 9–10, and in Month 12). At the beginning and end of the study, participants also completed a physical activity questionnaire (PAQ, described below).

Accelerometer-Measured Physical Activity

For each accelerometer measurement week, participants were instructed to wear an Actigraph accelerometer (MTI Actigraph; Fort Walton, FL) on the left hip (attached by an elastic belt) at all times except when sleeping, showering and swimming. Study personnel distributed and collected the Actigraph monitors, recorded the dates of monitor distribution and collection, checked monitor calibration status, and recalibrated monitors as required.

The Actigraph measures vertical acceleration 12 times per second, which is integrated over a prespecified epoch (1 min for this study) and converted to activity counts per minute (ct/min). Monitor wear time was estimated using an automated scoring algorithm developed by Troiano, *et al.*,¹⁶ employing an activity count threshold of ≥ 60 minutes to determine nonwear periods and a modified activity count threshold of ≥ 50 ct/min to determine wear periods. A valid day of observation included ≥ 10 hours of monitor wear time,¹⁶ and nonvalid days and measurement weeks with less than 2 valid days were excluded. Summary measures were calculated using average values over all valid days for total physical activity (ct/min/day ≥ 100 ct/min), sedentary time (min/day < 100 ct/min) and for time (min/day) spent in light (100–759 ct/min) and moderate-to-vigorous activity (≥ 760 ct/min), using previously described cut-points for sedentary behavior and light and moderate-to-vigorous activity.^{15,17,18} Additional analyses investigated sedentary behavior as a proportion of registered time, and a cut-point of 1952 ct/min was employed to define moderate-to-vigorous activity¹⁹ for comparison with previous studies.

Self-Reported Physical Activity

The PAQ was developed with reference to the Typical Week Physical Activity Survey²⁰ and assessed participation during the past year in activities from various domains, including: household; transportation; occupation and volunteer work; caring for others; leisure, recreation and exercise; stair climbing. For each of 26 items, participants reported in an open-ended format the number of months per year, the days per month, and the hours per day spent in each activity on days when they engaged in that behavior. Sedentary behavior included self-reported time spent sitting at work, in the car, at home, and watching TV.

Summary measures were calculated from reported frequency (months/year and days/month), duration (min/day), and intensity (METs) of physical activity using standard methods.²¹ Data from the two PAQ administrations were averaged for each summary measure, including total physical activity (MET-hrs/day ≥ 2.0 METs) and time (min/day) spent sedentary (< 1.5 METs) and in light (2.0–3.0 METs) and moderate-to-vigorous (> 3.0 METs) activity.

Demographic, Anthropometric, and Lifestyle Characteristics

For men, demographic (age, attained education, most recent occupation) data were collected during in-person interviews at baseline (2001–2006), whereas women reported this information at baseline on a self-administered questionnaire (1997–2000). For both men and women, anthropometry (height, weight, waist and hip circumference) was measured in-person by trained interviewers following a standard protocol. The BMI was calculated from weight and height (kg/m^2) and categorized according to standard cut-points for Asian populations (underweight= < 18.5 , normal weight= 18.5 – < 24.0 , overweight= 24.0 – < 28.0 , obese= ≥ 28.0).²² Total energy intake was assessed using a validated food frequency questionnaire,^{23,24} and history of cigarette smoking (current, former, never) was interrogated on a baseline lifestyle questionnaire. While gender and attained education would remain stable over the time interval between baseline assessment and physical activity measurement, it was taken into account that occupation, smoking status, BMI, waist-to-hip ratio, and possibly total energy intake may have changed over time.

Population for Analysis

Of 619 participants, 43 individuals with insufficient accelerometer data were excluded. For 31 of the remaining 576 participants, PAQ data were available from the first administration only.

Statistical Analysis

Examination of the distribution of total physical activity, moderate-to-vigorous activity, light activity and sedentary time by quantile–quantile plots revealed departure from normality. Therefore, these data were analyzed using nonparametric methods, and summary statistics are reported as medians and interquartile ranges (IQR).

The Student's t-test, the Chi-square test, and the Kruskal–Wallis test were used to evaluate differences in the study population by gender for variables that were continuous, categorical, and nonparametric continuous, respectively. The Kruskal–Wallis test and Cuzick's test for nonparametric trend were used to examine differences in physical activity across categories of characteristics of the study population.

Multiple logistic regression analyses examined the associations of participant characteristics with levels of physical activity and sedentary behavior. Each physical activity or sedentary behavior variable of interest was dichotomized at the median to create a binary outcome variable. Logistic regression analyses were adjusted for age, gender, BMI, total energy intake, attained education level (none, elementary school, middle school, high school, professional, college+), most recent occupation (farmer/worker, clerical, professional), and cigarette smoking (current, former, never). Models for the association of participant characteristics with accelerometry were additionally adjusted for monitor wear time. All analyses were performed in 2008–2009 using SAS Version 9.1 (Cary, North Carolina), and are two-sided with a significance level of $p < 0.05$.

RESULTS

Participants were an average age of 53.5 years, with a mean BMI of 23.7 kg/m² (Table 1). Just under 50% of the study population was educated to a high school level or above, and 56% of participants were most recently employed in manual occupations (farmers/workers). Current cigarette smoking was more prevalent among men than women (58% versus 3%, respectively, $p < 0.001$).

For over 78% of the study population, accelerometer data were available from 3 or more measurement periods ($M = 3.15$, $SD = 0.92$), and the average number of days per measurement week was above 5 ($M = 5.75$, $SD = 1.68$). Participants had at least 10 hours (600 min) of wear time on 71% of days measured ($M = 856$ min, $SD = 152$). Sedentary time made up the most minutes per day, and participants spent 80 min/day in moderate-to-vigorous activity when measured by accelerometry and self-reported 94 min/day of moderate-to-vigorous activity.

Table 2 presents patterns of accelerometer-measured physical activity according to participant characteristics using simple, bivariate statistical methods. Total physical activity and time spent in moderate-to-vigorous and light activity decreased with increasing age (p for trend < 0.001). In contrast, older individuals spent more time sedentary than younger participants (p for trend < 0.001). Compared with men, women spent more time in light activity (p -value < 0.001) but were less sedentary (p -value = 0.003). Individuals with the lowest level of educational attainment engaged in the least total activity (p for trend = 0.04), whereas those with the highest educational attainment spent the most time sedentary (p for trend < 0.001).

Participants with high BMI were less physically active overall (p for trend < 0.001) and spent less time in moderate-to-vigorous activity (p for trend = 0.002) and light activity (p for

trend=0.003) than subjects with normal BMI. In addition, total activity, moderate-to-vigorous activity and light activity decreased with increasing waist-to-hip ratio, and individuals with the highest waist-to-hip ratio spent more time sedentary (all p for trend ≤ 0.004). Increasing quartiles of total energy intake were positively associated with total activity, moderate-to-vigorous activity and light activity (all p for trend ≤ 0.02). Results were qualitatively similar for associations with sedentary behavior as a proportion of accelerometer wear time and with moderate-to-vigorous activity using a cut-point of 1952 ct/min (data not shown).

As anticipated based on the descriptive statistics in Table 2, in multivariate logistic regression analyses of accelerometer-measured physical activity and sedentary behavior, increasing age was related to lower levels of total activity (OR=0.29, 95% CI=0.17, 0.49) and moderate-to-vigorous activity (OR=0.26, 95% CI=0.15, 0.44), and it was positively related to sedentary behavior (OR=2.77, 95% CI=1.53, 5.05) (Appendix A, available online at www.ajpm-online.net). In addition, women were more likely than men to engage in light activity (OR=2.02, 95% CI=1.20, 3.42). Significant associations of most recent occupation or attained education level with accelerometer-measured physical activity or sedentary behavior were not observed.

Obese individuals were less likely than those with normal BMI to engage in a high level of accelerometer-measured total activity (OR=0.34, 95% CI=0.17, 0.66) or moderate-to-vigorous activity (OR=0.29, 95% CI=0.14, 0.59), and they were also suggestively more likely to spend time sedentary (OR=1.87, 95% CI=0.94, 3.71). Associations of accelerometer-measured physical activity and sedentary behavior with waist-to-hip ratio were weaker than those with BMI, with the exception of light activity, for which a significant inverse association with high versus low waist-to-hip ratio was noted (OR=0.48, 95% CI=0.26, 0.91); results were similar for men and women (data not shown). Additionally, currently smoking cigarettes was inversely related to total activity (OR=0.47, 95% CI=0.28, 0.78), and individuals in the highest quartile of energy intake were more likely to engage in total, moderate-to-vigorous and light physical activity, and were less likely to be sedentary than those in the lowest quartile of energy intake.

In general, analyses of self-reported physical activity were similar to those of accelerometer-measured activity (data not shown). For example, there was an inverse association of moderate-to-vigorous activity with current cigarette smoking and strong positive associations with total energy intake for self-reported physical activity variables. However, observed associations of age, gender and BMI with self-reported physical activity or sedentary behavior were inconsistent with those seen for accelerometry. For example, increasing age was related to a higher level of self-reported moderate-to-vigorous activity and less sedentary behavior, women reported spending more time in moderate-to-vigorous activity than men, and positive associations of BMI with self-reported total and moderate-to-vigorous activity did not reach significance. Furthermore, individuals with the highest level of educational attainment were more likely to self-report spending time sedentary than the least educated individuals.

DISCUSSION

This study used accelerometry to examine the prevalence of physical activity and sedentary behavior as well as the relationships of demographic, anthropometric and lifestyle characteristics with physical activity and sedentary behavior in urban Chinese adults. In this urban Shanghai population, physical activity levels decreased and sedentary behavior increased across consecutive age groups, similar to previous reports of accelerometer-measured physical activity in predominantly Caucasian adult populations.^{16,25} Furthermore, men and women with a greater BMI or waist-to-hip ratio were less physically active than lean individuals, and current cigarette smokers engaged in less physical activity than those who never or formerly smoked. In contrast with observations in Western populations,^{16,25} however, men were not more

physically active than women. In fact, women spent more time in light physical activity than did men.

On average, participants spent the most time per day in sedentary behavior, but 98% of participants accumulated at least 30 minutes per day of moderate-to-vigorous physical activity. When a higher cut-point for accelerometer-measured moderate-to-vigorous activity (1952 ct/min) was employed, 56% of the study population achieved this level of physical activity, similar to a Swedish study²⁵ in which 95% of participants accumulated 30 min/day of moderate-to-vigorous activity when the cut-point for defining moderate-to-vigorous activity was set at 760 ct/min or 52% when the cut-point was set at 1952 ct/min. Despite the influence of the selected moderate-to-vigorous cut-point on physical activity prevalence, associations with demographic, anthropometric and lifestyle factors were not sensitive to any change in cut-points.

The present study observed differences between accelerometry and self-report in the estimation of time spent in physical activity and sedentary behavior. Participants self-reported more moderate-to-vigorous activity than was measured by accelerometry, despite the relatively low cut-point for defining moderate-to-vigorous activity. This result could derive from participants over-reporting moderate intensity activities on the PAQ or from failure of the accelerometer to capture moderate intensity activities such as household chores, bicycling or swimming. For example, 45% of the present cohort reported cycling for transport or getting about on the PAQ (median 27 min/day), thus it is possible that the accelerometer underestimated total and moderate-to-vigorous activity. Similar to a study in Dutch adults,²⁶ better agreement was observed between accelerometer-measured and self-reported moderate-to-vigorous activity after excluding cycling (median of 76 min/day without cycling), although associations with participant characteristics did not change. In addition, less sedentary behavior was reported on the PAQ compared with accelerometer measurement, which may have resulted from participants under-reporting sedentary time,^{27,28} from under-ascertainment of sedentary behavior by the PAQ, or from overestimation of sedentary behavior by accelerometry. Most likely, a combination of the limitations of both instruments contributed to these discrepancies.

The demographic, anthropometric and lifestyle correlates of accelerometer-measured physical activity and sedentary behavior in this Shanghai population were largely similar to those characteristics observed in Western populations.^{9,16,25,29} In contrast with previous evidence based on self-reported physical activity and sedentary behavior,^{9,29} however, neither male gender nor attained education was positively associated with accelerometer-measured physical activity. Furthermore, distinct associations of gender and attained education with self-reported versus objectively measured physical activity and sedentary behavior were observed. Together, these results suggest that population subgroup-specific physical activity levels and/or physical activity reporting patterns exist.

For example, the authors did not observe an association of gender with accelerometer-measured moderate-to-vigorous activity, but women self-reported spending more time in moderate-to-vigorous activity than men. The bulk of the literature supports a higher level of activity among men,^{9,29} thus it is conceivable that women in the present study over-reported time spent in activities³⁰ such as cooking, cleaning, and laundry that are more prevalent among women than men^{10,31,32} and are not well captured by accelerometry.³³ Alternatively, women may have overestimated the intensity of domestic activities when self-reporting, as accelerometer results showed that women were more likely than men to engage in light activity. While accelerometer-measured physical activity and sedentary behavior were not associated with attained education in the current cohort or in one other study,²⁶ self-reported sedentary behavior was positively related to level of educational attainment. This finding is inconsistent with many,^{9,29,34–36} but not all^{37,38} studies of self-reported physical activity levels in relation to educational attainment.

Age was inversely associated with accelerometer-measured total activity and moderate-to-vigorous activity, suggesting that older people may be an ideal subgroup for physical activity promotion. Yet older individuals were more likely to self-report a high level of moderate-to-vigorous activity, which is consistent with previous studies in Shanghai^{10,11} and in other Asian adults,³⁹ but is in contrast with two reviews in Western adults.^{9,29} The observed associations of self-reported moderate-to-vigorous activity and sedentary behavior with age may have resulted from imprecise reporting by older individuals, from cognitive issues of recall or from differential perception of exertion by older compared with younger individuals.

Results from accelerometer measurements indicated that obese individuals and those with central adiposity were less active than leaner people, but individuals with a greater BMI self-reported suggestively more total activity. A positive association of BMI with self-reported physical activity is consistent with previous studies in Shanghai,^{10,11} and is intriguing since these relationships oppose those generally observed in Western populations for self-reported^{9,40,41} and objectively measured^{25,42,43} physical activity. It is possible that this unexpected association is the result of overweight and obese adults systematically over-reporting their physical activity levels, as noted in several studies,^{26,42,44–47} or the PAQ may misclassify activity levels among overweight individuals for whom less strenuous activities are likely of higher relative intensity.⁴⁸ Alternatively, if obese individuals wore the accelerometer positioned at a tilt, the monitor may have underestimated activity counts.⁴⁹

Similar to previous reports,^{9–11,50} inverse associations of physical activity with cigarette smoking were observed, although associations were significant for accelerometer-measured total and moderate-to-vigorous activity only. A positive relationship of physical activity variables with total energy intake across instruments is consistent with previous observations in Shanghai.^{10,11}

The cross-sectional design of this analysis limits further interpretation of the nature of relationships of physical activity and sedentary behavior with demographic, anthropometric and lifestyle factors. Furthermore, although characteristics of the study population were similar to the larger, population-based SWHS and SMHS cohorts in terms of age, BMI, education and smoking status (data not shown),^{51,52} the physical activity level of the study population may not be representative of urban Shanghai adults, as individuals who agree to participate in a study with such extensive measurement may differ from the general population. An additional limitation is that many of the participant characteristics evaluated in this study were measured prior to the physical activity measurement period. Although occupation, smoking status, BMI, waist-to-hip ratio and possibly total energy intake may have changed over time, gender and attained education are likely to be stable. In order to discern the direction and magnitude of these associations and to determine whether these characteristics determine or are the result of physical activity patterns, prospective studies or controlled trials are required.

In summary, this study of objectively measured physical activity among urban men and women from Shanghai, China, found that older people, obese individuals, and current cigarette smokers exhibited significantly lower levels of physical activity than their younger, more lean, and nonsmoking counterparts. The authors also present an unexpected result that women spent more time in light physical activity than men. In addition, no relationship of educational attainment to total physical activity or time spent sedentary was observed. Further investigation of physical activity patterns using objective methods will be necessary to determine whether declining physical activity levels are related to an increasing burden of chronic disease in China and beyond. Such work should also help to identify population subgroups that could benefit most from physical activity and public health promotion programs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1
 Characteristics of the study population, N=576 men and women in the Shanghai Physical Activity Study cohort

	Total (N=576)			Men (n=285)			Women (n=291)		
	M	(SD)		M	SD		M	SD	p value ^a
Age (yrs)	53.5	9.4		55.7	9.5		51.3	8.8	<0.001
Weight (kg)	63.4	10.5		67.2	10.7		59.7	8.8	<0.001
Height (m)	1.64	0.08		1.69	0.06		1.58	0.06	<0.001
BMI (kg/m ²)	23.7	3.3		23.4	3.3		24.0	3.2	0.02
Waist-to-hip ratio	0.85	0.07		0.89	0.06		0.81	0.05	<0.001
Total energy intake (kcal/day)	1811.1	454.4		1939.5	461.3		1685.4	410.9	<0.001
	n	%		n	%		n	%	p value ^b
Most recent occupation, farmers or workers	320	56		163	57		157	54	0.47
Attained education, high school or more	275	48		153	54		122	42	<0.001
Current cigarette smoking	172	30		164	58		8	3	<0.001
	Total (N=576)			Men (n=285)			Women (n=291)		
Accelerometer^c	Median	IQR		Median	IQR		Median	IQR	p value ^d
Total physical activity (ct/min/day)	264	205, 334		260	202, 333		270	207, 335	0.63
Moderate-to-vigorous activity (min/day)	80	58, 106		78	56, 104		81	58, 108	0.51
Light activity (min/day)	237	197, 278		227	192, 264		244	206, 295	<0.001
Sedentary behavior (min/day)	509	449, 572		517	463, 586		499	439, 561	<0.001
	Total (N=576)			Men (n=285)			Women (n=291)		
Self-report^e									
Total physical activity (MET- hour/day)	16	12, 21		15.1	11, 21		17	13, 22	<0.001
Moderate-to-vigorous activity (min/day)	94	60, 141		83	55, 137		100	65, 144	0.01
Light activity (min/day)	177	118, 256		158	103, 240		192	146, 266	<0.001
Sedentary behavior (min/day)	349	259, 447		367	270, 477		326	256, 433	0.02

^a p value for difference between men and women from t-test.

^b p value for difference between men and women from chi-square test.

^cCut-points for physical activity from accelerometer: total physical activity, ≥ 100 ct/min; moderate-to-vigorous physical activity, ≥ 760 ct/min; moderate-to-vigorous physical activity, ≥ 1952 ct/min; light physical activity, 100–759 ct/min; sedentary behavior, <100 ct/min.

^d*p* value for difference between men and women from Kruskal–Wallis test.

^eDefinitions of physical activity from self-report: total physical activity, ≥ 2.0 MET; moderate-to-vigorous physical activity, ≥ 3.0 MET; light physical activity, 2.0–3.0 MET; sedentary behavior, <1.5 MET.

Table 2

Prevalence of accelerometer-measured physical activity by categories of demographic, anthropometric and lifestyle factors

	<i>n</i> (%)	Total physical activity (ct/min/day) <i>a</i>			Moderate-to-vigorous activity (min/day) ^d			Light activity (min/day) ^d			Sedentary behavior (min/day) ^d		
		Median	IQR	Median	Median	IQR	Median	IQR	Median	IQR	Median	IQR	
Age (years)													
40–49	243	42	286	237, 358	86	67, 110	242	206, 290	491	424, 549			
50–59	171	30	267	211, 336	84	61, 110	242	204, 283	511	459, 581			
60+	162	28	221	164, 290	64	44, 83	215	181, 257	540	475, 593			
p-value ^b				<0.001		<0.001		<0.001		<0.001		<0.001	
Gender													
Male	285	49	260	202, 333	78	56, 104	227.4	192, 264	517.4	463, 586			
Female	291	51	270	207, 335	81	58, 108	243.5	206, 295	499.1	439, 561			
p-value ^c				0.63		0.51		<0.001		0.003			
Most recent occupation													
Farmers/Workers	320	56	266	204, 343	81	57, 110	241.0	199, 288	499	435, 562			
Clerical	102	18	263	211, 333	82	58, 103	240.1	197, 283	498	450, 551			
Professional	152	26	256	204, 314	77	58, 97	230.0	192, 272	537	480, 588			
p-value ^b				0.55		0.19		0.17		<0.001			
Attained education													
Elementary school or less	72	13	219	148, 296	66	38, 81	216	180, 278	526	435, 583			
Middle school	229	40	273	212, 348	84	60, 111	245	204, 291	490	439, 552			
High school	175	30	266	217, 329	80	62, 106	237	194, 276	510	453, 567			
Professional school, college or more	100	17	261	208, 333	78	58, 99	232	198, 257	544	482, 606			
p-value ^b				0.04		0.12		0.57		<0.001			
BMI (kg/m ²)													
Low (<18.5)	28	5	231	172, 348	67	45, 101	246	198, 282	536	466, 575			
Normal (18.5–<24)	273	48	279	226, 349	85	61, 112	242	204, 289	507	436, 557			
Overweight (24–<28)	218	38	263	205, 325	81	60, 100	233	192, 273	504	455, 574			
Obese (≥28)	55	10	207	168, 270	62	42, 79	215	181, 260	535	480, 603			

		Total physical activity (ct/min/day) <i>a</i>			Moderate-to-vigorous activity (min/day) ^d			Light activity (min/day) ^d			Sedentary behavior (min/day) ^d		
<i>n</i> (%)		Median	IQR	Median	IQR	Median	IQR	Median	IQR	Median	IQR	Median	IQR
p-value ^b													
Waist-to-Hip Ratio													
<0.80	139 24	292	228, 362	86	66, 117	250	214, 299	494	443, 542				
0.80–0.85	151 26	261	202, 316	78	58, 104	244	206, 297	507	435, 566				
>0.85–0.90	147 26	255	193, 326	78	55, 105	232	191, 272	510	458, 593				
≥0.90	139 24	256	191, 312	76	54, 100	216	184, 256	522	468, 584				
p-value ^c			0.001		0.004		<0.001		<0.001				
Cigarette smoking													
Never/Former	404 70	269	209, 334	80	59, 107	239	200, 279	506	448, 568				
Current	172 30	254	194, 334	78	52, 100	228	188, 272	515	450, 577				
p-value ^d			0.38		0.36		0.16		0.24				
Total daily energy intake, kcal quartiles													
1	143 1272.5	249	191, 313	75	55, 98	218	184, 264	520	448, 581				
2	142 1633.4	272	205, 317	80	58, 103	240	210, 283	508	452, 562				
3	144 1919.2	262	197, 334	78	56, 105	233	192, 276	512	447, 581				
4	147 2400.8	273	220, 364	86	59, 117	245	208, 290	500	442, 561				
p-value ^c			0.01		0.02		0.02		0.19				

^a Cut-points for physical activity from accelerometer: total physical activity, ≥100 ct/min; moderate-to-vigorous activity, ≥760 ct/min; light activity, 100–759 ct/min; sedentary behavior, <100 ct/min

^b p-value for test of trend using Cuzick's test for nonparametric trend

^c p-value for difference between groups using Kruskal–Wallis test

IQR, interquartile range