Television Viewing and Pedometer-Determined Physical Activity Among Multiethnic Residents of Low-Income Housing

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Objectives. We evaluated the association between television viewing and pedometer-determined physical activity among predominantly racial/ethnic minority residents of low-income housing in metropolitan Boston in 2005.

Methods. We used mixed models to analyze the association between reported hours of television viewing and pedometer-determined steps per day among 486 adults. We also examined whether television viewing was associated with the achievement of 10 000 steps per day.

Results. There was a mean 3.6 hours of average daily television watching. In multivariable analyses, each hour of television viewing on an average day was associated with 144 (95% confidence interval [CI] = –276, –12) fewer steps per day and a decreased likelihood of accumulating 10 000 steps per day (odds ratio [OR] = 0.84; 95% CI = 0.71, 0.99). Weekday and weekend television viewing were each also associated with fewer steps per day.

Conclusions. Average daily television viewing was associated with reductions in total pedometer-determined physical activity levels (approximately 520 steps per day) in this lower-income sample. As part of a comprehensive physical activity promotion plan, recommendations to reduce television viewing should be made. (*Am J Public Health.* 2006;96:1681–1685. doi:10.2105/AJPH.2005.080580)

Television viewing is a highly prevalent sedentary activity in the United States; on average Americans watch at least 4 hours of television each day,[1] and television viewing is the most time-consuming activity nationally—after work and sleep.[2] Watching television has been positively associated with excess body weight among both children and adults,[3–13] perhaps because the time that might otherwise be used to engage in physically active pursuits is used to watch television programs, and/or because media content promotes unhealthy dietary choices that negatively influence the foods that television viewers eat.

Surprisingly little research has systematically investigated the hypothesis that television viewing is inversely associated with physical activity among adults; there is, however, emerging evidence supporting the relation.[5,8,14,15] The literature investigating the association between television viewing and physical activity has exclusively utilized self-reported physical activity measures. Although commonly administered, the validity of self-reported physical activity estimates may be compromised by recall bias. This may be a particular problem among lower-income populations, who derive a comparatively higher proportion of their daily physical activity through participation in routine, non–leisure-time activities (e.g., domestic, occupational, and transportation)[16,17] that are more challenging to recall, compared with less incidental, higher-intensity leisure-time activities. With 1 exception,[8] previous studies have investigated the impact of television viewing on leisure-time physical activity, thus limiting the ability to derive estimates of how television viewing affects total physical activity.

We sought to evaluate the association between hours spent watching television and pedometer-determined physical activity in a sample of predominantly racial/ethnic minority residents of low-income housing. This population is of key concern given their high rates of television viewing,[9,18,19] physical inactivity,[20,21] and related health consequences.

METHODS

We gathered our data from the prerandomization baseline data collection of the Open Doors to Health study, a physical activity promotion and colon cancer screening intervention trial conducted in collaboration with 12 low-income housing communities in metropolitan Boston in 2005. Given the extended period of enrollment and data collection, we included data from participants in the first 7 sampled housing sites in 2004–2005.

Housing site representatives sent letters announcing the study to their eligible residents. Eligibility criteria for the study survey included (1) residence in the housing community, (2) age of at least 18 years, and (3) fluency in English or Spanish. Residents were able to opt out of the study by contacting either a housing site representative or a member of the research staff. After the initial announcement letter was sent, a random sample (in larger housing sites, more than 300 units) or census sample (in smaller housing sites, less than 300 units) of potential participants was drawn and individuals were either contacted by telephone or visited at home to inquire about their interest in participating in the study.

Of the 2057 individuals initially contacted, 329 were ineligible (including 14 with cancer histories), leaving 1728 potentially eligible individuals whom study staff attempted to recruit. Of these, 626 (36.2%) were unreachable (nonworking telephone number or 10 unanswered telephone calls and at least 3 unanswered door knocks), 342 (19.8%) refused, and 64 (3.7%) did not show up for appointments, leaving 696 (40.3%) with complete survey data. After enrollment, participants provided informed consent and completed an interviewer-administered survey in either English or Spanish.

Television Viewing

Using standard methods for measuring television exposure detailed elsewhere,[22] we asked participants to report the number of hours they spent watching television (1) on an average

weekday and (2) on an average weekend day. We used these variables to determine the average number of hours spent watching television on any day of the 7-day week; the variable was weighted to account for the greater number of weekdays than weekend days.

Pedometer Sampling Protocol

Our pedometer sampling protocol is described elsewhere in greater detail.[23] Briefly, participants were instructed to wear a pedometer that was blinded so that the accumulated step count would not be visible for 5 days, beginning with the day of survey administration, at all times except while bathing, showering, swimming, and sleeping. Pedometers were blinded to minimize reactivity and potential threats to sampling log validity resulting from reduced literacy levels. Pedometer sampling was implemented on all 7 days of the week, and, with the exception of those starting on Mondays, included at least 1 weekend day.

Participants wore the pedometer from the time they woke in the morning until they went to bed, except for those times previously noted. After the fifth day, participants were asked to remove the pedometer and place it in the previously provided storage container before going to bed; the pedometer was not to be removed from the container until it was returned to study staff (which was typically on the same or the next day). Upon receipt of the pedometer, staff removed the blinding tape and immediately recorded the accumulated steps.

The study pedometers (Yamax SW200, Lee's Summit, Mo) demonstrate high concordance with accelerometers (motion sensors that use a piezoelectric transducer to objectively measure physical activity intensity and duration with high precision) under both laboratory conditions and in field settings.[24,25] All pedometers were fully tested before use according to the strategy suggested by Tudor-Locke and Myers.[26] As an incentive, participants were given a $25 grocery store card upon completion of the data collection protocol.

Statistical Analysis

Six hundred ninety-six participants completed the survey. A subset of participants (n=137) were deemed ineligible to collect pedometer data because they were either not ambulatory or their literacy levels were too low to complete the sampling log. We also excluded from our analyses those participants who did not wear the pedometer for at least 3 days (n=52), those who returned broken pedometers (n=1), those who became incapacitated during the 5-day study period (n=3), those whose log data were incomplete (n=13), those who did not report any hours of television viewing (n=3), and those whose reported hours of television viewing were considered an extreme outlier (n=1)(>6 SD higher than the mean for both weekend and weekday viewing), leaving a total of 486 participants.

To examine the association between television viewing and steps per day, we used mixed models to control for clustering of participants within housing sites. Coefficients represent the difference in recorded steps per day associated with each additional hour of reported television viewing. In analyses of the 10 000-step threshold, we present odds ratios for meeting the step recommendation. In multivariable models, we adjusted for age, gender, race/ethnicity, body mass index (BMI; weight in kilograms divided by height in meters squared), employment status, and education. Because of challenges measuring height and weight in some sites, including logistical challenges with using equipment in sites that were multi-level or geographically dispersed, we used self-reported data for many participants (68%). As such, we included a term indicating whether height and weight data were measured or self-reported.

RESULTS

Study participants were mostly Black (45%) or Hispanic (38%) and were predominantly female (64%) (Table 1). Thirty-seven percent of participants had less than a high-school education; one quarter completed high school and the remaining 37% had some education after high school. Less than a third (32%) of participants were of normal weight; 31% were overweight and 37% were obese; mean BMI was 29.8 (7.2 SD). Thirty-nine percent of the participants were older than 60 years. Participants recorded a mean of 5329 (±3863.6 SD) steps per day.

Hours of television viewing on an average day of the week ranged from zero to 14.5 hours with a median of 3 hours and a mean of 3.6 hours. Participants reported the same range for weekdays, with a median of 3 hours and a mean of 3.6 hours. Weekend television viewing had a wider range (zero to 19 hours), a mean of 3.6 hours, and a median of 3 hours.

In multivariable analyses, each hour of weekday television viewing was associated with 148 fewer steps per day (−148; 95% CI=−276, −20) (Table 2). Weekend television viewing was similarly associated with 74 fewer steps per day (−74; 95% CI=−182, −34). On an average day during the 7-day week, each hour of television viewing was associated with 144 fewer steps per day (−144; 95% CI=−276, −12). Additional adjustment for self-reported versus measured BMI did not change any of the results (data not shown) and was excluded from subsequent analyses.

We also evaluated whether the association between television viewing and steps per day was modified by selected sociodemographic characteristics. A number of sociodemographic variables, including employment status, gender, race/ethnicity, and education, had significant bivariate associations ($P<.05$) with the 3 television measures (Table 2). Thus, we estimated a series of multivariable-adjusted interaction models examining the joint association of each of the 3 television-viewing measures (split at the median) with these sociodemographic variables. None of the interaction terms investigated achieved statistical significance (data not shown), although this may have been a result of limited power because of the small numbers in subgroups, which likely resulted from the relatively homogenous socioeconomic characteristics of the sample.

In exploratory analyses, we also evaluated the association between television viewing and the attainment of 10 000 steps per day—a threshold commonly used in pedometer-based physical activity promotion interventions, because it may roughly approximate achievement of the recommended daily levels of physical activity.[27–29] Television viewing was inversely associated with the attainment of 10 000 steps per day; each additional hour of television viewing on an average day of the week was associated with a 16% reduction in the likelihood of attaining 10 000 steps per day (odds ratio [OR]=0.84; 95% CI=0.71,

TABLE 1—Demographic Distribution of Participants, by Total Number of Participants, Average Steps Per Day, and Hours of Television Viewing on an Average Day of the Week (n = 486): Metropolitan Boston, 2005

	Participants, No. (%)	Steps/Day		Hours of Television on Average Day of Week	
		No. (SD)	*P*	No. (SD)	*P*
Race/ethnicity			.47		.01
Black	216 (44)	4650 (3703.2)		4.1 (3.0)	
White	35 (7)	6051 (3925.7)		2.1 (2.0)	
Hispanic	182 (38)	5905 (3964.5)		3.2 (2.5)	
Other	53 (11)	5656 (3771.4)		3.6 (2.5)	
Gender			.01		.01
Male	174 (36)	5857 (4222.2)		4.1 (2.9)	
Female	312 (64)	5034 (3261.3)		3.3 (2.6)	
Education			.84		.0004
Less than high school	181 (37)	4935 (3869.5)		4.2 (3.0)	
High school or vocational school	121 (25)	5288 (3884.6)		3.7 (2.7)	
Any post–high school	182 (38)	5729 (3839.9)		2.9 (2.3)	
Employment status			< .0001		< .0001
Full-time	91 (20)	7567 (4162.1)		2.6 (1.9)	
Part-time	61 (13)	6197 (4287.5)		2.8 (1.6)	
Disabled	99 (22)	4349 (3227.6)		5.3 (3.4)	
Not employed	203 (45)	4543 (3448.6)		4.0 (2.5)	
Age, y			< .0001		.31
< 30	66 (14)	6788 (4072.0)		3.6 (2.3)	
30–39	63 (13)	6870 (3922.7)		3.0 (2.4)	
40–49	80 (16)	6483 (3996.1)		3.3 (2.5)	
50–59	90 (18)	5101 (3990.0)		3.9 (3.1)	
60–69	110 (23)	4304 (3117.7)		4.0 (3.0)	
≥70	76 (16)	3217 (2771.3)		3.3 (2.8)	
Body mass index			.01		.09
< 25	157 (32)	6064 (4191.7)		3.8 (3.0)	
25–29.9	151 (31)	5511 (3583.6)		3.3 (2.6)	
≥30	178 (37)	4531 (3661)		3.6 (2.6)	

Note. Age was calculated on the basis of participants' reported date of birth. Participants were asked to report their race/ethnicity as Black, White, Hispanic, Asian, American Indian, or Other. Participants were permitted to select more than 1 option; those who selected Hispanic were coded as such, regardless of other options selected. Participants choosing more than 1 of the other 5 race/ethnicity options were assigned to a Mixed Race/Ethnicity category. Participants reported their highest level of educational attainment, which was collapsed because of small numbers. Employment status was self-reported and grouped because of small numbers in some groups. Body mass index was grouped into standard categories (normal, < 25; overweight, 25–29.9; and obese, > 30).

0.99) in multivariable analyses with adjustment for age, gender, race/ethnicity, BMI, employment status, and education (data not shown).

DISCUSSION

We found that television viewing was associated with pedometer-determined physical activity (on both weekdays and weekends) in a sample of predominantly racial/ethnic minority residents of low-income housing. Average daily television viewing was associated with a reduction of approximately 520 steps, or almost 10% of the average daily steps per day in this sample. Although television viewing has been previously identified as a primary sedentary pursuit, surprisingly few studies have systematically reported its association with physical activity patterns among adults, and none have used an objective measure of total accumulated physical activity. Our use of pedometers provides data that reflect total daily physical activity and are generally free from the recall bias typically associated with self-report measures.

We found that, for each hour of television viewing on an average day, there was a 16% decrease in the likelihood of meeting the 10 000-steps-per-day threshold for that day. Although it has its origins as a corporate marketing strategy,[29] the 10 000-steps-per-day message has gained widespread use as a public health intervention message,[29,30] and emerging evidence suggests that it may approximate achievement of national physical activity guidelines.[27–29] Those watching the average amount of daily television in this sample were 47% less likely to achieve 10 000 steps per day (calculated by $e^{\ln(0.84)\times 3.6} = 0.53$). This perhaps more clearly demonstrates the effects that excess television viewing might have on members of this low-income population attempting to meet recommended guidelines for physical activity.

Two predominant hypotheses have been offered to explain the previously demonstrated association between television viewing and obesity: (1) media content (e.g., advertising, television shows) that emphasizes unhealthy dietary practices and (2) television viewing displaces time that might be spent in physically active pursuits. Although we demonstrated an association between television viewing and physical activity, the magnitude of the effect was not as large as might be expected if physical activity were to mediate the association between television viewing and obesity in this population. Our results are consistent with previous findings[31] that have similarly shown that television viewing may have a less profound effect on physical activity than might be predicted. Taken together, these findings suggest that the television–obesity relation may not primarily be a function of the displacement of physical activity in adults. Future research on the role that television plays in obesity should explore this and other potential mechanisms for the association.

TABLE 2—Association Between Hours Spent Watching Television and Steps per Day

Overall	Age- and Gender-Adjusted β (95% CI)[a]	Multivariable Adjusted β (95% CI)[b]
Average day of the week	−192 (−309, −75)	−144 (−276, −12)
Average weekday	−194 (−307, −82)	−148 (−276, −20)
Average weekend day	−113 (−214, −12)	−74 (−182, −34)

[a]b represents difference in steps per day associated with each additional hour of television viewing reported.
[b]Covariates included age, gender, body mass index, race/ethnicity, education, and employment status.

The characteristics of our study population may largely account for the limited strength of the association between television viewing and physical activity. Populations of lower socioeconomic position tend to obtain a greater proportion of their total daily activity from non-leisure activity (transportation, occupational activity).[16,17] Television viewing is likely to displace only leisure-time physical activity, so one might expect the association to be greater among those with more discretionary time to pursue leisure activities. Thus, it is possible that a population of higher socioeconomic position, with more discretionary time, would demonstrate an association of greater magnitude between television viewing and physical activity.

Nevertheless, television viewing may be only 1 of many potentially high-frequency sedentary domestic behaviors (e.g., resting, reading, computer use) that are associated with physical inactivity. For example, whereas African Americans have the highest levels of television viewing, they also have among the highest rates of newspaper-reading and radio-listening patterns[18]—behaviors that may have a higher metabolic expenditure than television viewing,[32] but as replacement activities may be similarly deleterious with respect to their impact on total physical activity. Thus, interventions designed solely to motivate individuals to watch fewer hours of television may have minimal benefits for total physical activity promotion. We posit that many individuals may replace television with similarly low-intensity domestic activities unless physical activity is explicitly emphasized as a replacement for television viewing. This may particularly be the case for low-income populations, among whom television viewing may be functional; for example, formative qualitative research in this population found that many residents (particularly those of older age) reported watching television daily because of their social isolation and concerns about neighborhood safety.

Several considerations may limit interpretation of our findings. Our sampling strategy is supported by the results of a recent validation study[33] that found that any 3 days (weekday or weekend) are sufficient to reliably estimate physical activity performed in a free-living week. A higher response rate would have been desirable; challenges experienced at the 2 initial housing sites (during the study's startup phase) most negatively influenced the estimate. The response rate improved dramatically when the first 2 sites were excluded (66.8% for the latter 5 sites). As with similar self-report indexes, our television-viewing exposure is subject to reporting biases; however, it is a widely used and cognitively tested measure.

Unfortunately, objective television-monitoring devices both are prohibitively expensive for observational research purposes and are currently unable to yield valid estimates of individual television-viewing patterns. Ideally, we would have had measured height and weight among all participants. However, this was not feasible in some housing sites (and some participants refused), so self-reported height and weight were used. We found that adjusting for BMI measurement did not influence our results. Finally, these data are cross-sectional, and thus we were unable to establish the causal direction of these findings. As such, they should be considered preliminary in nature.

The amount of time Americans spend watching television weekly is rapidly approaching the length of the average workweek. Accumulating evidence clearly supports the recommendation to reduce hours of television viewing as part of a comprehensive plan to increase physical activity (and to reduce obesity). However, such plans should also include specific recommendations for television-replacement strategies that require the exertion of physical activity. ■

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Contributors

G.G. Bennett originated the study, oversaw the analyses, and led the writing. K.Y. Wolin conducted the data analysis and assisted with the writing and interpretation of the findings. S. Askew conducted the literature review and contributed to the writing. E. Puleo assisted with the data collection and contributed to the writing. V. Viswanath assisted with the interpretation of the findings and contributed to the writing. K.M. Emmons originated the parent study, assisted with interpretation of the findings, and assisted with the writing.

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Human Participant Protection

The study protocol was approved by the Harvard School of Public Health's human subjects committee.

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