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Reliability and Validity of the Sedentary Behavior Questionnaire (SBQ) for Adults

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Background: Sedentary behavior is related to obesity, but measures of sedentary behaviors are lacking for adults. The purpose of this study was to examine the reliability and validity of the Sedentary Behavior Questionnaire (SBQ) among overweight adults. ***Methods:*** Participants were 49 adults for the 2 week test-retest reliability study (67% female, 53% white, mean age = 20) and 401 overweight women (mean age = 41, 61% white) and 441 overweight men (mean age = 44, 81% white) for the validity study. The SBQ consisted of reports of time spent in 9 sedentary behaviors. Outcomes for validity included accelerometer measured inactivity, sitting time (International Physical Activity Questionnaire), and BMI. Intraclass correlation coefficients (ICCs) assessed reliability and partial correlations assessed validity. ***Results:*** ICCs were acceptable for all items and the total scale (range = .51–.93). For men, there were significant relationships of SBQ items with IPAQ sitting time and BMI. For women, there were relationships between the SBQ and accelerometer inactivity minutes, IPAQ sitting time, and BMI. ***Conclusions:*** The SBQ has acceptable measurement properties for use among overweight adults. Specific measures of sedentary behavior should be included in studies and population surveillance.

Keywords: television, sitting, overweight, BMI, measurement

Sedentary behaviors including watching television and sitting at a computer are increasingly the focus of research seeking to understand the mechanisms of obesity. There is substantial evidence that sedentary behavior is related to obesity and other health outcomes independent of physical activity.[1–6] Though an individual may meet physical activity recommendations for health by exercising 30 minutes per day, that leaves 16 or more hours that could be spent in completely sedentary pursuits (driving to work, sitting at work, driving home, sitting and watching television, etc) or in low intensity activities (eg, slow walking, playing with children, housework). A pattern of sedentarism throughout the day appears to adversely affect health, even when meeting physical activity recommendations.[5,7] Few self-report measures of sedentary behavior have been validated even though they are needed to advance understanding of this class of risk behaviors.[8,9] Measuring sedentary behavior also is important for population level public health surveillance and to assess change resulting from intervention programs.

Sedentary behaviors, particularly television watching, have been examined primarily among children and adolescents and there are some reliable[10] and validated reports of children's television watching.[11,12] Less has been reported on measures for adult sedentary behavior. A recent review examined measures of leisure time sedentary behavior and while 9 studies assessed reliability, only 3 assessed validity.[13] The researchers excluded measures of sedentary behavior that included assessment of workplace and transportation sedentary behaviors. Television viewing time was most commonly assessed. Validation measures included heart rate monitoring,[14] behavioral logs or activity diaries,[15,16] and accelerometry.[15] Only Salmon et al's measure[16] assessed sedentary behaviors other than television viewing and computer use.

National epidemiological surveys among adults sometimes include measures of sedentary behaviors (eg, television watching and computer use in NHANES) but others (eg, Behavioral Risk Factors Surveillance System, BRFSS) assess physical activity only.[17] Sedentary behavior is included in some validated measures of physical activity. For example, the International Physical Activity Questionnaire (IPAQ) assesses time spent sitting and has some support for reliability and validity.[9,18] However, the IPAQ only assesses sitting in general and driving/riding in motor vehicles and provides no information on other types of sedentary behavior. Another physical activity measure, the Flemish Physical Activity Computerized Questionnaire, includes items assessing television, video, and playing computer games and showed evidence of reliability and validity.[15] Though more detailed than the IPAQ, the Flemish measure lacks information on

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the wider variety of sedentary behaviors that individuals often engage in such as sitting while doing work or riding in a car.

Validated measures of the range of sedentary behaviors that occupy adults' time, rather than only assessing television viewing time, are needed for more complete estimates of adult sedentary behavior. The purpose of the current study was to test the reliability and validity of a measure of sedentary behavior for use with overweight adults. Concurrent validity was tested using another validated self-report measure of sedentary behavior and accelerometery. Construct validity was assessed using body mass index (BMI) as it has been established that sedentary behavior is related to obesity.[1–6,19] Additionally, demographic correlates of sedentary behavior were explored.

Methods

Participants

Data for this study were from 3 sources, which included a convenience sample and 2 randomized controlled trials (RCT). The convenience sample consisted of 49 adults (67% female, 53% non-Hispanic white, mean age = 20.4 (standard deviation, SD, = 1.3) who completed surveys to examine test-retest reliability of the sedentary measure as well as other surveys. The RCTs evaluated low intensity web-based diet and physical activity weight loss interventions. The first RCT included 401 overweight [body mass index (BMI) between 25 and 40 kg/m^2] women (mean age = 41.2; SD = 8.7), 61% non-Hispanic white, mean BMI = 32.4 (SD. = 4.5), 46% college degree or higher, 67% married or living with a partner, 71% 1 or more children).[20] Participants were recruited from 7 physician office sites in San Diego County. The second RCT enrolled 441 overweight (BMI greater than 25 kg/m^2) men (mean age = 43.9 (SD = 8.0), 81% non-Hispanic white, mean BMI = 34.2 (SD = .41), 63% college degree or higher, 70% married, 65% 1 or more children).[21] Participants were recruited via newspaper advertisements and flyers. Validity data for the current analyses were from baseline assessment of the RCTs and included both control and intervention participants. Ethical approval for both studies was obtained from San Diego State University and the University of California, San Diego.

Measures

The Sedentary Behavior Questionnaire (SBQ) was adapted from a measure used in children that has some evidence of reliability and validity.[22–24] It was designed to assess the amount of time spent doing 9 behaviors (watching television, playing computer/video games, sitting while listening to music, sitting and talking on the phone, doing paperwork or office work, sitting and reading, playing a musical instrument, doing arts and crafts, sitting and driving/riding in a car, bus, or train). The 9 items were completed separately for weekdays and weekend days. Wording for weekday reporting was, "on a typical weekday, how much time do you spend (from when you wake up until you go to bed) doing the following?" For the weekend, wording was the same except "weekday" was replaced with "weekend day." Response options were none, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, or 6 hours or more. The time spent on each behavior was converted into hours (eg, a response of 15 minutes was recoded as .25 hours). For the total scores of sedentary behavior, hours per day for each item were summed separately for weekday and weekend days. To obtain weekly estimates, weekday hours were multiplied by 5 and weekend hours were multiplied by 2 and these were summed for total hours/week. For the summary variables of total hours/day spent in sedentary behaviors (weekday and weekend) and total sedentary hours/week, responses higher than 24 hours/day were truncated to 24 hours/day.

The Actigraph accelerometer (model WAM 7164) is a valid measure of physical activity.[25,26] In the current study, minute-by-minute accelerometer readings were used to measure sedentary time defined by accelerometer counts <100 per minute. Treuth et al[27] identified <100 counts per minute as an optimal sedentary cutpoint for adolescent girls, but the same cutoff could be expected to be generalizable to other populations. Indeed, while the <100 counts per minute sedentary cutoff is not uniformly agreed upon, it has been commonly used in research on sedentary behaviors.[9,18,28,29] The Actigraph stored acceleration counts at 1-minute intervals. A monitored hour was not considered valid if the number of consecutive minutes of 0 counts exceeded 30 minutes. Data from the monitors were considered valid if the monitor was worn for at least 3 of the 7 days and for at least 10 hours each day.[25] Participants with less than 3 valid days of accelerometer data were not included in analyses. In addition, total moderate (lower cut point of 1952 counts) and vigorous physical activity (lower cut point of 5725 counts) as measured with accelerometers was used for validity analyses.[30] Participants were instructed to wear their accelerometers from the time they woke up in the morning until the time they went to bed at night, removing the monitor only to bathe or swim. Monitors were worn on a nylon belt fitted securely around the waist with the monitor positioned on the right hip.

The long form of the International Physical Activity Questionnaire was administered to participants and contained 2 items that assessed time spent sitting. One item assessed weekday sitting while the other item assessed weekend sitting. The items stated, "during the last 7 days how much time did you usually spend sitting on a weekday [or weekend day]?" Total hours spent sitting per week was calculated following the IPAQ scoring protocol (weekday sitting $\times$ 5 + weekend sitting $\times$ 2). An additional item asked respondents the hours per day they spent in a motorized vehicle. Time spent in a motorized vehicle per week was added to the total time spent sitting resulting in total hours/week spent sitting from the IPAQ. This measure has been found reliable and valid.[9,18] To

assess concurrent validity, sedentary behavior measured from the SBQ was compared with reported sitting time from the IPAQ.

Finally, objectively measured height and weight were used to calculate BMI. The equation used to calculate BMI was weight (kg) ÷ [height (m)].[2]

Study Procedures

For test-retest reliability, participants in the convenience sample completed identical pen and paper measures in a quiet setting at 2 time points across a 2-week interval. After receiving directions from a research assistant that emphasized the importance of reading each item carefully and completely filling in the circle next to their answer choice, participants completed a survey booklet that contained the SBQ among other questionnaires.

For validity analyses data, women and men enrolled in separate but similar sex-specific randomized controlled trials of health promotion and weight control interventions targeting physical activity and multiple dietary outcomes. The 1-year intervention was delivered mainly through the internet, with periodic e-mail and telephone contact. All measures used in present analyses were collected at baseline, before randomization. Participants completed survey measures in a quiet setting at the study research office on computers and were instructed to wear the accelerometer for the next 7 days before mailing it back to the research office. Height and weight were measured by trained research assistants. Participants were compensated $15 for completing the measurement visit.

Statistical Analyses

Test-retest reliability of each item was assessed in the convenience sample (N = 49) in which measures were completed twice separated by a 2-week interval. One-way intraclass correlation coefficients (ICCs) determined reliability, with coefficients interpreted following Landis and Koch's benchmarks of agreement: .00 to .20, slight; .21 to .40, fair; .41 to .60, moderate; .61 to .80, substantial; and .81 to 1.00, almost perfect.[31] Nonparametric Spearman's rho coefficients were also computed to compare with the ICCs to determine if departures from normality of the distribution of item values impacted the reliability estimates.

Validity coefficients were conducted using partial correlations adjusted for age, ethnicity (white or nonwhite), highest education level (some high school, some college, college graduate, or post graduate degree), marital status (married/living with partner vs single, separated, widowed, or divorced), and number of children in the home. Overweight male and female samples were analyzed separately. Demographic correlates were explored using analysis of covariance models that adjusted for all other demographics. SPSS version 15.0 was used to conduct analyses.

Results

Descriptive statistics for each sedentary behavior questionnaire item as well as weekday, weekend, and total hours spent in sedentary behaviors are in Table 1. Men

Table 1 Mean Hours/Week and Standard Deviations (SD) for All Sedentary Behavior Questionnaire Items and Summary Scores for Men and Women

	Women (N = 401)		Men (N = 441)	
Item[a]	Mean (median)	SD	Mean (median)	SD
TV*	16.9 (16.0)	9.8	18.4 (16)	9.5
Computer games**	3.4 (1.3)	6.4	5.5 (2.3)	7.8
Sit listen to music	4.9 (2.0)	7.7	4.9 (2.5)	7.2
Sit talk on telephone*	6.7 (3.5)	8.2	5.3 (2.3)	6.8
Office/paper work**	18.6 (17.0)	12.9	21.2 (22)	12.3
Reading	6.1 (4.5)	6.2	5.5 (4.5)	5.2
Play musical instrument**	.2 (.0)	1.2	.7 (.0)	3.0
Arts and crafts**	2.4 (.0)	5.0	.8 (.0)	2.9
Sitting driving in a car	10.2 (7.0)	7.4	10.3 (7.0)	6.9
Total sedentary hours/week	64.6 (60.0)	26.7	66.6 (63.5)	24.9
Total weekday (hours/day)**	10.3 (10.0)	4.6	9.0 (8.3)	3.9
Total weekend (hours/day)**	8.8 (8.25)	3.9	10.8 (10.5)	4.0

[a] Item response options were 0 = 'None,' 1 = '15 minutes or less,' 2 = '30 minutes,' 3 = '1 hour,' 4 = '2 hours,' 5 = '3 hours,' 6 = '4 hours,' 7 = '5 hours,' 8 = '6 hours or more.'

* $P < .05$ for the difference between men and women.

** $P < .01$ for the difference between men and women.

spent significantly more time watching television, using the computer/playing video games, doing office work, playing an instrument, and being sedentary on weekends while women spent more time talking on the phone, doing arts and crafts, and being sedentary on weekdays.

Reliability

Among the reliability sample (N = 49), Table 2 presents the individual item 2-week test-retest ICCs. All items and the total score demonstrated moderate to excellent reliability for weekdays (range = .64–.90) and weekend days (range = .51–.93) with most items in the substantial reliability range based on the Landis and Koch benchmarks.[31]

Validity

Criterion validity tests are presented in Tables 3 and 4. For men (see Table 3), there were no significant relationships between SBQ scores and accelerometer minutes with counts < 100 or total physical activity. The IPAQ sitting time measure was related to television, listening to music, phone, office work, driving in a car, weekday, weekend, and total SBQ scores. BMI was significantly related to television, weekday, and total SBQ scores. The correlation between motorized transportation measured with the IPAQ and time spent driving in a car, bus, or train from the SBQ were high (partial $r = .54$, $P < .01$).

For women (see Table 4), correlations between the SBQ items and accelerometer minutes with counts < 100 were statistically significant for TV time, office work, playing a musical instrument, and weekend scores. IPAQ sitting time was significantly associated with television, telephone, office work, reading, weekday, weekend, and total SBQ scores. BMI was significantly associated with television, weekday, and total SBQ scores. The correlation between motorized transportation time measured with the IPAQ and time spent sitting in a car from the SBQ were high (partial $r = .44$, $P < .01$).

There were no differences in sedentary behavior by number of children, marital status, age, or education for both men and women (data not shown). However, there were differences by ethnicity for both groups so this variable was further explored. There were several ethnic/racial differences for men and women between those classified as nonwhite (including Latinos) compared with whites (see Table 5). Nonwhite men had significantly higher television, computer, music, weekday, weekend, and total SBQ scores than white men. Nonwhite women had higher music, telephone, sitting while driving, weekday, weekend, and total sedentary time scores on the SBQ as compared with white women.

Table 2 Adult Test-Retest for Sedentary Behavior Questionnaire Items and Total Score (N = 49)

	ICC (95% CI)		Spearman's rho (95% CI)	
SBQ Item	**Weekday**	**Weekend day**	**Weekday**	**Weekend day**
TV	.857 (.761, .917)	.828 (.715, .899)	.867 (.775, .923)	.847 (.743, .911)
Computer games	.829 (.716, .899)	.801 (.673, .882)	.833 (.721, .903)	.814 (.691, .891)
Sit listen to music	.708 (.536, .824)	.672 (.485, .800)	.688 (.504, .812)	.641 (.439, .781)
Sit talk on telephone	.808 (.684, .887)	.730 (.567, .838)	.794 (.660, .879)	.637 (.433, .779)
Office/paper work	.772 (.630, .865)	.638 (.439, .610)	.673 (.483, .802)	.637 (.433, .779)
Reading	.642 (.443, .780)	.482 (.237, .670)	.641 (.439, .781)	.586 (.365, .745)
Playing musical instrument	.896 (.823, .940)	.925 (.871, .957)	.894 (.819, .939)	.927 (.873, .958)
Arts and crafts	.703 (.529, .820)	.510 (.272, .690)	.701 (.523, .820)	.752 (.597, .853)
Sitting driving in car	.757 (.608, .855)	.724 (.559, .834)	.758 (.606, .857)	.749 (.593, .851)
Total scale	.848 (.747, .911)	.770 (.626, .863)	.789 (.653, .876)	.742 (.582, .847)

Abbreviations: ICC = Intraclass correlation coefficient; CI = confidence interval.

In addition, among women, marital status was related to SBQ scores. Those who were married or living with a partner had significantly lower total sedentary behavior (adjusted mean = 66.49 hours/week) compared with single, divorced, or widowed women (adjusted mean = 75.39 hours/week; $F(1, 392) = 7.10$, $P = .008$). For specific sedentary behaviors, women who were married or living with a partner had lower hours per week spent: watching TV (adjusted mean = 15.83 vs. 19.10; $P = .003$), reading (adjusted mean = 5.53 vs. 7.16; $P = .02$), on the phone (adjusted mean = 6.12 vs. 8.00; $P = .045$), and listening to music (adjusted mean = 4.10 vs. 6.68; $P = .003$) than those who were not married or living with a partner.

Table 3 Validity Associations (Partial Correlations) for the Overweight Male Sample (N = 354)*

SBQ score	Accelerometer mins with counts < 100 partial *r* (*P*)*	Accelerometer total activity mins/day partial *r* (*P*)*	IPAQ total sitting time—including transport hours/day partial *r* (*P*)*	BMI partial *r* (*P*)*
TV	–.001 (.99)	.02 (.74)	.20 (.00)	.18 (.001)
Computer	.01 (.84)	.003 (.95)	.06 (.24)	.08 (.13)
Listen to music	.01 (.79)	–.02 (.75)	.11 (.04)	.04 (.51)
Talk on telephone	–.08 (.13)	–.01 (.87)	.17 (.001)	.02 (.74)
Office/paper work	.003 (.95)	–.004(.95)	.31 (.00)	.01 (.83)
Reading	.01 (.87)	–.06 (.28)	.02 (.66)	.03 (.61)
Play musical instrument	.04 (.47)	.02 (.67)	.00 (.99)	.02 (.70)
Arts and crafts	–.04 (.51)	–.003 (.96)	.04 (.46)	.02 (.73)
Sitting driving in a car	.03 (.60)	–.04 (.41)	.19 (.00)	–.04 (.45)
Weekday (hours/day)	–.02 (.78)	–.03 (.56)	.24 (.00)	.11 (.04)
Weekend (hours/day)	–.005 (.93)	–.005 (.93)	.38 (.00)	.09 (.11)
Total hours/week	–.01 (.81)	–.03 (.63)	.31 (.00)	.11 (.03)

* Adjusted for age, marital status, white or nonwhite ethnicity, number of children, and highest level of education.

Table 4 Validity Associations (Partial Correlations) for the Overweight Female Sample (N = 300)*

SBQ score	Accelerometer mins with counts < 100 partial *r* (*P*)*	Accelerometer total activity mins/day partial *r* (*P*)*	IPAQ sitting time hours/day partial *r* (*P*)*	BMI partial *r* (*P*)*
TV	.12 (.04)	–.08 (.19)	.26 (.00)	.14 (.01)
Computer	.04 (.49)	–.05 (.36)	.05 (.41)	.09 (.14)
Listen to music	.01 (.94)	–.10 (.09)	.02 (.69)	.10 (.07)
Talk on telephone	.04 (.47)	–.02 (.79)	.12 (.03)	–.04 (.51)
Office/paper work	.17 (.002)	–.04 (.47)	.33 (.00)	–.07 (.23)
Reading	.01 (.91)	.01 (.91)	.11 (.05)	.05 (.36)
Play musical instrument	.26 (.00)	–.05 (.38)	–.11 (.07)	–.02 (.74)
Arts and crafts	.06 (.31)	–.08 (.18)	.07 (.26)	.18 (.002)
Sitting driving in a car	–.04 (.47)	.09 (.14)	.07 (.26)	–.11 (.06)
Weekday (hours/day)	.06 (.32)	–.07 (.19)	.21 (.00)	.13 (.02)
Weekend (hours/day)	.18 (.002)	–.08 (.18)	.36 (.00)	.05 (.42)
Total hours/week	.10 (.07)	–.08 (.15)	.28 (.00)	.12 (.05)

* Adjusted for age, marital status, white or nonwhite ethnicity, number of children, and highest level of education.

Table 5 Sedentary Behaviors by Race/Ethnicity for the Male and Female Samples: Means, Standard Errors (SE), and Effect Sizes

	Male sample			Female sample		
SBQ score	White adjusted mean (SE)**	Non-white adjusted mean (SE)**	Partial ETA²	White adjusted mean (SE)**	Non-white adjusted mean (SE)**	Partial ETA²
	N = 310	N = 128		N = 244	N = 155	
TV	17.7 (.53)	20.3 (.85)	.02 [b]	16.8 (.61)	17.0 (.77)	.00
Computer	4.6 (.43)	7.5 (.69)	.03 [a]	3.1 (.41)	4.0 (.52)	.00
Listen to music	4.2 (.41)	6.8 (.65)	.03 [a]	4.0 (.48)	6.4 (.61)	.02 [a]
Talk on telephone	5.1 (.40)	5.8 (.63)	.00	6.1 (.52)	7.8 (.66)	.01 [b]
Office/paper work	21.5 (1.11)	20.3 (.70)	.00	18.2 (.84)	19.2 (1.06)	.00
Reading	5.5 (.30)	5.8 (.48)	.00	6.1 (.39)	6.0 (.50)	.00
Play musical instrument	.5 (.18)	1.1 (.28)	.01	.26 (.08)	.10 (.10)	.01
Arts and crafts	.91 (.17)	.42 (.27)	.01	2.3 (.32)	2.4 (.40)	.00
Sitting driving in a car	10.0 (.39)	11.0 (.62)	.00	9.4 (.48)	11.4 (.60)	.02 [a]
Weekday (hours/day)	8.7 (.22)	9.8 (.35)	.02 [a]	8.3 (.24)	9.5 (.31)	.02 [a]
Weekend (hours/day)	10.5 (.23)	11.6 (.37)	.01 [b]	9.9 (.29)	11.0 (.37)	.01 [b]
Total hours/week	64.4 (1.40)	72.1 (2.23)	.02 [a]	61.3 (1.66)	69.6 (2.10)	.02 [a]

** Adjusted for age, BMI, highest level of education, marital status, number of children.

[a] $P < .01$ for the difference.

[b] $P < .05$ for the difference.

Discussion

The present results provide initial support for the reliability and validity of the Sedentary Behavior Questionnaire as a brief yet comprehensive assessment of sedentary behaviors for overweight adults. Overall reliability of the SBQ items and total scores was acceptable. Test-retest reliability was higher for weekday than weekend sedentary behaviors, possibly because weekend time use is more variable and time spent doing sedentary behaviors may naturally vary. Certain types of sedentary behaviors, like reading and doing arts and crafts, had lower test-retest reliability possibly due to low means and restricted range.

The validity of the SBQ was low when compared with accelerometers and appeared to be lower than correlations reported in other studies of reported sedentary behaviors. There were no significant correlations with accelerometer-assessed sedentary time for men in the current study, and though there were several significant correlations for women, the highest was $r = .26$. These findings represent very different results based on participant gender. Men and women may differ in the accuracy of their reports, with men being less accurate reporters of their sedentary behaviors than women, but this finding needs replication.

One previous study found a large range in correlations across population subgroups from different countries (ranging from –.48 to .56) comparing the IPAQ sitting item to accelerometer minutes with counts < 100.[9] Another study used a combination of accelerometers and 7-day activity diaries and found higher correlations ranging from .15 to .88.[15] Low correlations in the current study could be due to adjustment for more demographic variables than in other studies. Perhaps the nature of the sample affected the results. All participants in the validity analyses were overweight or obese, and validity of physical activity self-reports among these populations have been found to be systematically lower than in healthy-weight samples.[32–34] The variability in accelerometer estimates of sedentary behavior may be somewhat reduced in this sample of overweight adults compared with a more heterogeneous sample with respect to body weight, which would potentially result in lower correlations. Finally, there are no widely agreed upon cutoffs for measuring sedentary behaviors with accelerometers. More research is needed to determine the best accelerometer count cutpoints to classify sedentary behavior.

Concordance with the IPAQ sitting item was modest. High correlations were not anticipated as the IPAQ measure is based on 3 items asking participants to calculate the total time spent sitting in general and while driving or riding in a vehicle. The SBQ has participants assess the time spent in 9 specific sedentary behaviors, which is a much different cognitive task. Inquiring about specific sedentary behaviors (as the SBQ does) may have an advantage of being easier to recall than all sedentary behaviors at once. The IPAQ sitting items may be

particularly useful for population surveillance surveys which require brevity. However, capturing specific information on different domains of sedentary behavior could be important for more specific studies on sedentary behaviors and for interventions. Studies that aim to reduce time spent watching television will require measures of that specific behavior. Different types of sedentary behavior (eg, television watching versus playing video games) may have different relationships to health. There is evidence among youth, for example, that television viewing is related to snacking which could promote weight gain,[35] while playing video games could be less related to eating unhealthy foods as it is generally difficult to eat while holding a game controller.[36] Objective measures, such as accelerometers, have the benefit of being unbiased. However, these measures lack specificity, so self-reports will likely always provide additional valuable information about sedentary behaviors that are undertaken.

Based on previous research and theory, BMI was expected to be inversely related to sedentary behavior time. The strongest evidence of construct validity came from the associations with measured BMI, which was significant for both men and women. Importantly, the only SBQ item related to BMI was television viewing, which is consistent with several other studies.[1,6,7,37] However, the total scores were also significantly related to BMI. TV time can contribute to obesity through low energy expenditure, concurrent eating, and the influence of the thousands of food commercials viewers are exposed to annually.[38–40] It is notable that television viewing and total sedentary time were associated with BMI even among these overweight and obese samples who have restricted range in BMI. These findings suggest that reducing television and total sedentary time could aid weight loss in adults, similar to its contribution to weight loss among obese children.[41,42]

There is no agreement on whether sedentary behavior displaces time spent being physically active.[43] Some evidence suggests there are only small negative associations between sedentary behavior and moderate to vigorous physical activity in youth[44] suggesting that the displacement hypothesis may not be correct. A recent review found sedentary behavior was associated with health outcomes "generally independent of leisure-time physical activity."[13] In the current study, SBQ scores were unrelated to physical activity. This suggests that the SBQ can be used to measure the distinct class of low energy expenditure behaviors. The results further suggest that being sedentary should not be inferred from low levels of moderate to vigorous physical activity.[45]

The differential associations between sedentary time from the SBQ and ethnicity support the construct validity of the measure. For example, previous studies have shown black and Hispanic youth spend more time watching television than white youth.[46,47] More research is needed with diverse population segments to further assess differences in sedentary behaviors by race/ethnicity among adults.

Study limitations include the limited generalizability of the findings beyond overweight adults with high levels of education and self-identified as primarily white non-Hispanic. Because the survey contained multiple sedentary behaviors that may not be mutually exclusive (ie, people can multitask), some individuals reported doing more sedentary behavior than there are hours in the day. However, this was the case for only 6 participants in each sample. Reporting more than 24 hours of sedentary behavior in a day could also reflect the limited accuracy inherent in self-report measures. Strengths of the study included use of objective measures of sedentary behavior and BMI as validation criteria and separate analyses for overweight men and women.

The results of this study provide initial evidence for the reliability and validity of the SBQ. However, further assessment is needed in other population segments. Not all of the SBQs items may be relevant to different population segments under study. Thus, measures of sedentary behaviors may need to be tailored for populations such as older adults and low income populations. As new options for sedentary behaviors become available, the SBQ will need to be modified. In conclusion, program evaluation and population surveillance studies should include measurement of sedentary behaviors as they appear to have effects on obesity independent of physical activity. The SBQ provides a brief but comprehensive measure of sedentary behavior.

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