Accelerometer-measured sedentary time among Hispanic adults: Results from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

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A B S T R A C T
Excessive sedentary behavior is associated with negative health outcomes independent of physical activity. Objective estimates of time spent in sedentary behaviors are lacking among adults from diverse Hispanic/Latino backgrounds. The objective of this study was to describe accelerometer-assessed sedentary time in a large, representative sample of Hispanic/Latino adults living in the United States, and compare sedentary estimates by Hispanic/Latino background, sociodemographic characteristics and weight categories. This study utilized baseline data from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) that included adults aged 18–74 years from four metropolitan areas (N = 16,415). Measured with the Actical accelerometer over 6 days, 76.9% (n = 12,631) of participants had >10 h/day and >3 days of data. Participants spent 11.9 h/day (SD 3.0), or 74% of their monitored time in sedentary behaviors. Adjusting for differences in wear time, adults of Mexican background were the least (11.6 h/day), whereas adults of Dominican background were the most (12.3 h/day), sedentary. Women were more sedentary than men, and older adults were more sedentary than younger adults. Household income was positively associated, whereas employment was negatively associated, with sedentary time. There were no differences in sedentary time by weight categories, marital status, or proxies of acculturation. To reduce sedentariness among these populations, future research should examine how the accumulation of various sedentary behaviors differs by background and region, and which sedentary behaviors are amenable to intervention.

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Introduction
Sedentary behavior is defined as any waking activity characterized by an energy expenditure ≤1.5 metabolic equivalents (METS) in a sitting or reclining posture (Sedentary Behaviour Research Network, 2012). There is a consistent and growing body of evidence that sedentary behavior negatively impacts individuals’ health independent of physical activity (Thorpe et al., 2011; Wilmot et al., 2012; Prince et al., 2014; Hamilton et al., 2008). For example, a meta-analysis found that even in studies adjusting for physical activity, there remained a 2.5 times higher risk of diabetes among the most sedentary individuals (Wilmot et al., 2012). Prolonged sedentariness is known to disrupt metabolic function, increase plasma triglyceride levels, decrease high-density lipoprotein cholesterol and insulin sensitivity (Tremblay et al., 2010), and is associated with an increased risk of cardiovascular disease (Allison et al., 2012), metabolic syndrome (Cooper et al., 2014), incident hypertension (Beunza et al., 2007), and cancer (Schmid and Leitzmann, 2014). Although there is an increased cardiometabolic risk associated with sedentariness after adjusting for physical activity (Healy et al., 2011a; Henson et al., 2013; Qi et al.), individuals who interrupt prolonged sedentary behavior with light physical activity, such as sit-to-stand transitions, have been found to have improved

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cardiometabolic profiles compared to those who did not (Tremblay et al., 2010; Healy et al., 2015).

Many chronic disease processes linked to excessive sedentaryness (e.g., diabetes) disproportionately affect Hispanic/Latinos compared to non-Hispanic Whites (Cowie et al., 2010). However, sedentary behavior research has been largely restricted to non-Hispanic Whites (Rhodes et al., 2012), with the few studies examining sedentary time in Hispanic/Latinos from the US consisting predominantly of individuals of Mexican background (De Heer et al., 2012; Matthews et al., 2008; Eveson et al., 2014). The Hispanic/Latino population residing in the US is diverse in terms of immigration, generation status, types of occupation, acculturation status, and health literacy, and should not be considered a single homogenous racial/ethnic group (Brown and Patten, 2014). Further, time spent in various sedentary behaviors may vary by background (Thompson et al., 2013), which has implications for interventions aimed at reducing sedentary behaviors among different Hispanic/Latino populations. An additional limitation of earlier work in sedentary research is that studies have relied on self-reported sedentary behavior (Healy et al., 2011b), but recalling the amount of time spent in past sedentary activities is difficult (Van Uffelen et al., 2011) and self-report surveys are subject to cultural biases (Nicaise et al., 2011).

While considering the aforementioned limitations of the extant literature, this study aimed to: (i) examine the descriptive epidemiology of accelerometer-assessed sedentary time in a large representative sample of Hispanic/Latino adults living in the US, (ii) compare the amount of sedentary time among different Hispanic/Latino groups, and (iii) compare the amount of sedentary time among Hispanic/Latino adults across sociodemographic characteristics and weight categories.

Methods

Study population and design

The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) is a longitudinal cohort study of 16,415 Hispanic/Latino adults (ages 18–74 years) from 4 United States (US) metropolitan areas (Bronx, New York; Chicago, Illinois; San Diego, California; and Miami, Florida). Baseline information was obtained from 2008–2011. The goals of the HCHS/SOL sample design and cohort selection have been reported in detail elsewhere (Lavange et al., 2010; Sorlie et al., 2010). The Institutional Review Board at each field center approved this study and all participants gave written informed consent.

Sedentary-time assessment

Participants were instructed to wear the Actical version B-1 accelerometer (model 198-0200-03; Philips-Respironics Co. Inc., Bend, OR) for 6 days during waking hours. The Actical is a small, lightweight omnidirectional accelerometer worn around the waist on an elasticized belt. The Actical samples raw acceleration data at 32 Hz, which is then filtered and aggregated over a user-defined period (‘epoch’). The Actical has evidence for validity to measure sedentary behavior in free-living populations (Crouter et al., 2006; Wong et al., 2011).

Participants left the clinic visit wearing the Actical and were instructed to wear it during all waking hours for seven days as they went about their usual activities, removing the Actical only for sleeping. Participants were instructed to wear the Actical version B-1 accelerometer worn around the waist on an elasticized belt. The Actical is a small, lightweight omnidirectional accelerometer (model 198-0200-03; Philips-Respironics Co. Inc., Bend, OR) for 6 days during waking hours. The Actical is a small, lightweight omnidirectional accelerometer worn around the waist on an elasticized belt. The Actical samples raw acceleration data at 32 Hz, which is then filtered and aggregated over a user-defined period (‘epoch’). The Actical has evidence for validity to measure sedentary behavior in free-living populations (Crouter et al., 2006; Wong et al., 2011).

Participants left the clinic visit wearing the Actical and were instructed to wear it during all waking hours for seven days as they went about their usual activities, removing the Actical only for sleeping. Participants needed to contribute >3 adherent days of 6 to be included in the analyses.

There is some evidence that time spent being sedentary varies by day of the week when assessed via self-report (Burton et al., 2012) and objective measurement (Evenson et al., 2015). In studies where sedentary behavior is objectively measured, it is often not tenable to require that a participant contribute at least one weekend day of data to be included in the analysis due to substantial data loss associated with this requirement. However, it is possible to enhance the robustness of individual, day-level estimates by separately considering how sedentary time is accumulated by day of the week. To this end, the present study created the following formula to estimate individual’s daily sedentariness: ((average weekday sedentary time × 5) + (average weekend sedentary time × 2)) / 7). If individuals did not contribute a weekend day of wear, average wear time was calculated as the average daily sedentariness based on number of days the Actical was worn. Among individuals contributing at least one weekend day of wear, there was a small but significant within-person difference with more minutes/day of sedentary time being accumulated on weekdays (M = 726, SE = 1.7) compared to weekends (M = 718, SE = 1.9; t(11,209) = 5.8, P < .001).

Actical sample

Of the 16,415 enrolled participants, 1262 individuals did not return the Actical and 232 did not have a start date within one day of their clinic visit. In addition, 127 had spurious data including no sedentary time on any adherent day (n = 5), average wear time greater than or equal to 23 h/day (n = 119), and repeated counts indicative of device malfunction (n = 3). A remaining 2163 were excluded because they had less than 3 days of adherent wear time, leaving a final sample of 12,631 participants.

Socio-demographic characteristics

Socio-demographic characteristics self-reported during the baseline exam included: age, gender, Hispanic/Latino group, household income, education, marital employment, health insurance status, language preference, born in US mainland, and years residing in on the US mainland.

Weight characteristics

Participants’ height was measured to the nearest centimeter and body weight to the nearest 0.1 kg. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. BMI categories were defined as underweight (<18.5 kg/m² Thorp et al., 2011), normal weight (18.5–24.9 kg/m² Thorp et al., 2011), overweight (25.0–29.9 kg/m² Thorp et al., 2011), and obese (>30.0 kg/m² Thorp et al., 2011) (National Heart Lung and Blood Institute, 1998).

Weight characteristics

Participants reported their usual sleep separately on weekdays and on weekends by answering the following questions: “What time do you usually go to bed?” and, “What time do you usually wake up?” Sleep duration for weekdays and weekends were derived from the two questions and average weekly sleep duration was calculated as: ((weekday sleep time × 5) + (weekend sleep time × 2)) / 7). Sleep data were used in the present study to estimate participants’ waking day (defined as 24 h minus sleep in hours). Participants’ Actical wear time was compared to their waking day to determine adherence to wear time protocols. Given the effect of device wear time on...
sedentary estimates (Tudor-locke et al., 2011), it is important to determine what percent of individuals’ waking day is being monitored.

**Statistical analyses**

Analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC) and SPSS version 20 (IBM, Armonk, NY). Means were weighted using the product of an Actical non-response weight (to weight the results for the compliant subset back to the whole HCHS/SOL sample) and an HCHS/SOL sampling weight (to further weight the results back to the Hispanic/Latino population in the target areas). The sampling weight accounted for bias due to differential nonresponse in the sample at the household and person levels and for cluster sampling and the use of stratification in sample selection (Lavange et al., 2010). The weights were trimmed to limit precision losses due to the sampling and the use of stratification in sample selection (Lavange et al., 2010). The weights were further adjusted by using inverse probability weighting (Seaman and White, 2011). The inverse probability weight was created from a logistic regression model predicting compliance with device wear (Evenson et al., 2015). The SURVEYREG procedure in SAS was used to obtain least-squared means of daily sedentary time by gender, age, background, and sociodemographic and weight characteristics. All models adjusted for wear time, field center, and the wear time by center interaction. To accurately estimate sedentary time within adherent days (e.g., gender + age + background) other interactions were included as appropriate. Sensory time was adjusted for wear time because longer device wear is associated with greater sensory time estimates (Tudor-locke et al., 2011). In the present study, the two variables were highly correlated (r = 0.8, P < .001).

**Sensitivity analysis**

To explore the impact of wear time on sensory estimates, the sample was further restricted to participants who wore the Actical < 16 h/day, the average number of monitored hours in each adherent day for the full sample, while adjusting for the average wear time of this subsample (M = 13.7 h/day). Data were also explored to assess whether differences in sociodemographic variables by field center explained the long Actical wear times observed.

**Results**

Table 1 presents descriptive statistics on sociodemographic and weight characteristics of participants contributing adherent Actical data. Among the 12,631 participants contributing adherent data, 12,605 reported their ethnic background. The mean number of days the Actical was worn was 5.2 (SD 1.0) out of a possible 6 days, and 89% (n = 11,210) had at least one adherent weekend day. The average wear time within adherent days was 16 h (SD 2.9; IQR = 14–18). Across all backgrounds, unweighted wear-time adjusted average daily sensory time was 11.9 h (SD 3.0) and individuals spent 74% of their wear time in sensory behaviors (11.7 sensory hours/day/16 h of monitoring). Hispanic/Latino background was closely related to field center (e.g., most adults of Dominican (95%) and Puerto Rican (72%) background were from the Bronx) (Appendix). As has been found in previous work (Healy et al., 2008), spending more time being sedentary was associated with less light physical activity (r = −.3; P < .0001).

**Differences by background, gender, and age**

Participants spent between 71% (11.6 h; Mexican background) and 77% (12.3 h; Dominican background) of their Actical wear time being sedentary. Adults from a Mexican background were less sedentary.

### Table 1

| Characteristic | n (%) | Mexican (N = 5192) | Puerto Rican (N = 2089) | Cuban (N = 1680) | Central American (N = 1217) | Dominican (N = 1178) | South American (N = 846) | Other/multi-ethnic (N = 347) |
|---------------|-------|-------------------|------------------------|-----------------|-----------------------------|---------------------|------------------------|-----------------------------|
| Age, years    |       |                   |                        |                 |                             |                     |                        |                             |
| 18–34         | 1141  (44) | 359 (35)          | 197 (26)               | 293 (43)        | 259 (42)                    | 140 (32)            | 138 (63)               |                             |
| 35–49         | 1873  (33) | 605 (31)          | 553 (31)               | 435 (31)        | 379 (31)                    | 315 (36)            | 103 (21)               |                             |
| 50–64         | 1807  (18) | 866 (25)          | 728 (26)               | 461 (20)        | 443 (21)                    | 322 (24)            | 83 (11)                |                             |
| 64–74         | 371   (51)  | 259 (9)           | 202 (17)               | 84 (6)          | 97 (7)                      | 69 (8)              | 23 (5)                 |                             |
| Men           | 1937  (47) | 862 (51)          | 799 (52)               | 517 (48)        | 422 (39)                    | 335 (48)            | 153 (46)               |                             |
| Annual household income |       |                   |                        |                 |                             |                     |                        |                             |
| < $20,000     | 2030  (37) | 973 (6)           | 820 (46)               | 617 (47)        | 600 (46)                    | 363 (41)            | 119 (31)               |                             |
| $21–$50,000   | 2294  (43) | 646 (31)          | 511 (30)               | 443 (34)        | 403 (36)                    | 358 (42)            | 140 (45)               |                             |
| > $50,000     | 576   (15)  | 288 (13)          | 109 (8)                | 75 (7)          | 67 (7)                      | 74 (10)             | 54 (17)                |                             |
| Unreported    | 292   (5)   | 182 (10)          | 240 (16)               | 138 (12)        | 108 (10)                    | 51 (8)              | 34 (7)                 |                             |
| Education     |       |                   |                        |                 |                             |                     |                        |                             |
| High School   | 2346  (36) | 814 (37)          | 392 (22)               | 536 (38)        | 502 (36)                    | 209 (22)            | 85 (24)                |                             |
| > High School | 1320  (30) | 566 (28)          | 475 (30)               | 290 (27)        | 242 (25)                    | 211 (29)            | 65 (15)                |                             |
| Employment    |       |                   |                        |                 |                             |                     |                        |                             |
| Retired       | 345   (5)   | 458 (16)          | 175 (12)               | 76 (5)          | 124 (8)                     | 59 (5)              | 23 (5)                 |                             |
| Unemployed    | 1875  (38) | 821 (45)          | 777 (45)               | 461 (37)        | 443 (44)                    | 257 (33)            | 142 (40)               |                             |
| Employed ≤ 35 h/week | 1023  (20) | 191 (11)          | 204 (12)               | 267 (22)        | 167 (17)                    | 204 (23)            | 56 (22)                |                             |
| Employed > 35 h/week | 1932  (37) | 571 (28)          | 517 (31)               | 465 (36)        | 399 (31)                    | 313 (39)            | 119 (34)               |                             |
| Marital status|       |                   |                        |                 |                             |                     |                        |                             |
| Single        | 979   (28)  | 775 (48)          | 358 (26)               | 368 (39)        | 404 (47)                    | 175 (29)            | 137 (51)               |                             |
| Married/living with partner | 3276  (59) | 794 (34)          | 912 (51)               | 666 (46)        | 499 (37)                    | 474 (51)            | 140 (34)               |                             |
| Separated/divorced/ widow(er) | 930   (12)  | 518 (18)          | 406 (23)               | 238 (14)        | 275 (16)                    | 197 (20)            | 69 (15)                |                             |
| Foreign born* | 4413  (76) | 1260 (52)         | 1618 (93)              | 1218 (93)       | 1086 (85)                   | 812 (94)            | 163 (44)               |                             |
| Weight status |       |                   |                        |                 |                             |                     |                        |                             |
| Underweight or healthy weight | 1006  (22) | 404 (21)          | 375 (25)               | 265 (24)        | 231 (23)                    | 210 (28)            | 72 (24)                |                             |
| Overweight    | 2055  (39) | 698 (13)          | 668 (37)               | 492 (39)        | 458 (39)                    | 343 (41)            | 112 (31)               |                             |
| Obese         | 38,88 (39) | 979 (45)          | 636 (38)               | 515 (37)        | 485 (38)                    | 292 (31)            | 163 (45)               |                             |

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* Sample sizes are unweighted.
* Percentages may not sum to 100 due to rounding.
* Other/multi-ethnic were also of Hispanic/Latino origin.
* Foreign born is defined as being born outside of one of the 50 contiguous United States.
than all groups with an absolute mean difference ranging from 24 min (compared to Other/multi-ethnic) to 42 min (compared to Dominican) (Table 3). However, across all groups, time spent being sedentary was higher from ages 35–49 years (+12 min/day among women).

Older adults were not consistently more sedentary than younger adults (Table 2). Across most background groups, men and women age 35–49 years were less sedentary than men and women age 18–34 years (Table 3). However, across all groups, time spent being sedentary was higher from ages 35–49 to 50–64 to 65–74 years.

Differences by sociodemographic and weight characteristics

Men and women in the highest annual household income bracket (≥$50,000) were more sedentary than those in the lowest income bracket (≤$20,000) by approximately 24 min/day (Table 4). Among men, having more than a high school degree was associated with more sedentary time compared to those with less than a high school degree by approximately 24 min/day. Retired and unemployed individuals were more sedentary than employed individuals. For example, men employed ≥35 h/week were 1.2 h/day less sedentary than men who were unemployed. Sedentary time did not meaningfully differ by marital status, country of birth, years lived in the US, language preference, or weight status.

Sensitivity analysis

Although the primary analyses adjusted for Actical wear time, and hence accounted for the variance explained by differences in wear time between individuals, the long wear time observed in the present study influenced the sedentary time estimates. Whereas previous research among a nationally representative sample observed average accelerometer wear time of approximately 14 h/day (Matthews et al., 2008), Actical wear time in the present study was 14 to 18 h per day. Longer, versus shorter, wear time indicates favorable compliance with study protocols but excessive wear time suggests deviation from protocol such as wearing the Actical to sleep.

When comparing individuals’ Actical wear time to their estimated waking day, the average wear time among individuals of Dominican and Puerto Rican background was longer than their estimated waking day. Therefore, some participants of Dominican and Puerto Rican background, or those recruited from the Bronx, may have worn their Actical while sleeping (Appendix). We contacted the measurement staff at the Bronx site and were unable to identify a systematic breach in study practices.

Table 3

| Gender | Background | Total | 18–34 | 35–49 | 50–64 | 65–74 |
|--------|------------|-------|-------|-------|-------|-------|
|        |            | N     | M     | CI    | N     | M     | CI    | N     | M     | CI    | N     | M     | CI    |
| Women  | Mexican    | 3255  | 11.9  | 11.8, 12.0 | 640  | 11.6  | 11.5, 11.8 | 1197  | 11.4  | 11.2, 11.5 | 1176  | 11.9  | 11.7, 12.2 | 242   | 12.7  | 12.5, 12.9 |
|        | Puerto Rican | 1227  | 12.2  | 12.0, 12.4 | 171  | 11.9  | 11.6, 12.2 | 347   | 12.0  | 11.8, 12.2 | 545   | 12.1  | 11.7, 12.6 | 164   | 12.8  | 12.5, 13.1 |
|        | Cuban      | 881   | 12.3  | 12.2, 12.5 | 99    | 12.2  | 11.9, 12.4 | 284   | 12.0  | 11.8, 12.2 | 391   | 12.3  | 12.1, 12.5 | 167   | 12.9  | 12.7, 13.2 |
|        | Central American | 756   | 12.3  | 12.1, 12.4 | 140   | 11.9  | 11.7, 12.2 | 265   | 11.6  | 11.4, 11.8 | 304   | 12.0  | 11.8, 12.2 | 47    | 13.5  | 13.0, 14.0 |
|        | Dominican   | 756   | 12.4  | 12.2, 12.6 | 146   | 12.0  | 11.7, 12.3 | 266   | 12.2  | 11.7, 12.6 | 281   | 12.3  | 12.0, 12.6 | 63    | 13.1  | 12.8, 13.5 |
|        | South American | 511   | 12.2  | 12.0, 12.4 | 64    | 12.0  | 11.6, 12.4 | 189   | 11.7  | 11.4, 12.0 | 212   | 12.1  | 11.8, 12.4 | 46    | 13.2  | 12.8, 13.5 |
|        | Other/multi-ethnic | 194   | 12.1  | 11.7, 12.4 | 70    | 12.0  | 11.5, 12.4 | 64    | 11.7  | 11.4, 12.1 | 46    | 11.9  | 11.1, 12.6 | 14    | 12.8  | 11.8, 13.8 |
| Men    | Mexican    | 1937  | 11.4  | 11.2, 11.5 | 501   | 11.1  | 10.9, 11.3 | 676   | 10.7  | 10.4, 10.9 | 631   | 11.3  | 11.1, 11.5 | 129   | 12.3  | 12.0, 12.6 |
|        | Puerto Rican | 862   | 12.0  | 11.8, 12.1 | 188   | 11.3  | 11.2, 12.2 | 258   | 11.3  | 11.0, 11.6 | 321   | 11.9  | 11.5, 12.2 | 95    | 12.9  | 12.4, 13.3 |
|        | Cuban      | 799   | 11.9  | 11.9, 12.3 | 98    | 11.7  | 11.3, 12.2 | 269   | 11.5  | 11.3, 11.7 | 337   | 12.1  | 11.9, 12.4 | 95    | 13.1  | 12.9, 13.4 |
|        | Central American | 517   | 11.9  | 11.7, 12.1 | 153   | 11.4  | 11.1, 11.7 | 170   | 11.5  | 11.2, 11.9 | 157   | 11.9  | 11.6, 12.2 | 37    | 12.8  | 12.1, 13.4 |
|        | Dominican   | 422   | 12.2  | 12.0, 12.5 | 113   | 12.3  | 11.9, 12.6 | 113   | 11.6  | 11.0, 12.2 | 162   | 12.0  | 11.6, 12.2 | 34    | 13.1  | 12.6, 13.5 |
|        | South American | 335   | 12.0  | 11.7, 12.2 | 76    | 11.7  | 11.3, 12.1 | 126   | 11.4  | 10.9, 11.9 | 110   | 12.1  | 11.7, 12.5 | 23    | 12.7  | 12.1, 13.3 |
|        | Other/multi-ethnic | 153   | 11.9  | 11.4, 12.3 | 68    | 11.7  | 11.1, 12.3 | 39    | 11.6  | 11.0, 12.1 | 37    | 11.5  | 10.7, 12.3 | 9     | 12.7  | 11.4, 14.0 |

* All values are weighted for study design, calibrated using the 2010 Census population, and adjusted for Actical non-response.

a Estimates are least-square means adjusted for mean Actical wear time (15.87 h/day), field center, and field center - wear time as well as other interactions as necessary to obtain estimates by subgroups.

b Other/Multi-ethnic were also of Hispanic/Latino origin.
protocol in terms of how participants were instructed to wear the Actical. Further, not all participants from the Bronx had excessive Actical wear time.

When the sample was restricted to participants who wore the Actical < 16 h/day, the average wear time in the present study, sedentary time for all groups was reduced by approximately 15% (Tables 5–6). Individuals of Dominican background remained the most sedentary (10.5 h/day) (Table 5), which was driven by sedentary estimates of men of Dominican background (Tables 6). Women remained more sedentary than men (Table 6). No differences in sleep duration or employment (e.g., shift work) by field center were observed (data not shown).

Discussion

This study provides accelerometer-measured day-level estimates of time spent in sedentary behavior among an ethnically diverse sample of Hispanic/Latino adults living in the US. The overall differences between Hispanic/Latino groups were small except for when comparing individuals of a Mexican background to those from other backgrounds. Individuals of Mexican background were less sedentary than other groups by a range of 24 min/day (Other/multi-ethnic) to 42 min/day (Dominican). This may, in part, be explained by the finding that adults of Mexican background engage in more light physical activity than individuals of other Hispanic/Latino backgrounds (Arredondo et al.; Gay and Buchner, 2014), which likely displaces a significant amount of sedentariness given the strong negative correlation between sedentary and physical activity — as observed in the present study and elsewhere (Healy et al., 2008).

Further, differences in types of employment may account for differences in sedentary time by background. For example, there is some evidence that Mexican adults residing in the United States engage in more occupational physical activity than those from other backgrounds (Gay and Buchner, 2014), which suggests that they may have less

Table 4
Mean (95% CI) of sedentary time (hours/day) overall, by gender, sociodemographic characteristics and weight status, HCHS/SOL 2008–2011a,b.

| Annual household income | Total (N = 12, 416) | Men (N = 4,954) | Women (N = 7,462) |
|-------------------------|---------------------|-----------------|-------------------|
| $20,000                 | 12.01               | 11.91, 12.11    | 11.8, 12.1        |
| $21–50,000             | 12.04               | 11.92, 12.16    | 11.7, 12.0        |
| >$50,000               | 12.38               | 12.21, 12.55    | 12.1, 12.5        |
| Unreported             | 12.09               | 11.94, 12.24    | 11.6, 12.1        |
| Education              |                     |                 |                   |
| High School            | 1.24                | 12.13, 12.36    | 12.0, 12.3        |
| High School grad       |                     |                 |                   |
| > High School          |                     |                 |                   |
| Employment status      |                     |                 |                   |
| Retired                | 12.59               | 12.43, 12.76    | 12.4, 12.8        |
| Unemployed             | 12.51               | 12.40, 12.63    | 12.3, 12.6        |
| Employed < 35 h/week   | 1.82                | 11.06, 11.97    | 11.4, 11.8        |
| Employed > 35 h/week   | 1.59                | 11.48, 11.71    | 11.2, 11.5        |
| Marital status         |                     |                 |                   |
| Single                 | 12.22               | 12.08, 12.35    | 12.1, 11.9, 12.3  |
| Married/living with partner | 12.03            | 11.91, 12.14    | 11.7, 12.0        |
| Separated/divorced/divorced child | 12.14 | 12.01, 12.27 | 11.7, 12.2        |
| Country of birth and years in the US |         |                 |                   |
| Born in US Mainland    | 12.16               | 11.99, 12.33    | 11.7, 12.2        |
| Foreign born and in US < 10 years | 12.16   | 12.04, 12.27    | 11.9, 12.3        |
| Foreign born and in US > 10 years | 12.07  | 11.92, 12.22    | 11.7, 12.2        |
| Language preference    |                     |                 |                   |
| Spanish                | 12.09               | 11.96, 12.21    | 11.8, 12.1        |
| English                | 12.17               | 12.03, 12.32    | 11.8, 12.3        |
| Weight status          |                     |                 |                   |
| Underweight/healthy weight | 12.12            | 11.98, 12.25    | 11.8, 12.2        |
| Overweight             | 12.06               | 11.95, 12.18    | 11.7, 12.0        |
| Obese                  | 12.21               | 12.10, 12.32    | 11.9, 12.3        |

Table 5
Mean (95% CI) of sedentary time (hours/day) by Hispanic/Latino background and age, HCHS/SOL 2008–2011 restricted to participants with < 16 h of device wear (N = 7000)a,b,c.

| Background and Age | Total (N = 7000) | 18–34 | 35–49 | 50–64 | 65–74 |
|--------------------|-----------------|-------|-------|-------|-------|
| Mexican            | 10.3            | 9.7   | 9.5   | 9.5   | 9.5   |
| Puerto Rican       | 10.1            | 10.0  | 9.7   | 9.7   | 9.7   |
| Cuban              | 10.2            | 10.5  | 10.0  | 10.0  | 10.0  |
| Central American   | 10.0            | 9.7   | 9.7   | 9.7   | 9.7   |
| Dominican          | 10.1            | 10.0  | 9.8   | 9.8   | 9.8   |
| Other/multi-ethnic | 10.2            | 10.0  | 10.0  | 10.0  | 10.0  |

*All values are weighted for study design, calibrated using the 2010 Census population, and adjusted for Actical non-response.

b Estimates are least-square means adjusted for mean Actical wear time (15.87 h/day), field center, and field center + wear time as well as other interactions as necessary to obtain estimates by subgroups.

Other/multi-ethnic were also of Hispanic/Latino origin.
opportunity to accumulate sedentary time during the workday. Workplace sitting significantly contributes toward the accumulation of daily sedentariness. For example, on workdays, individuals with sedentary jobs walk and stand less, and accumulate more sedentary time during their leisure time (Thorp et al., 2012).

Observed differences in sedentary time by household income, education, and employment may also be due to differences in occupational versus leisure-time sedentary behaviors. More educated Hispanic/Latino men were more sedentary than less educated men, which may be explained by type of employment (i.e., white collar jobs requiring more sitting). Higher income was also associated with more time spent being sedentary, which could similarly reflect type of employment. In contrast, being retired/unemployed was associated with more sedentary time compared to those who were employed, which may, in part, be due to leisure-time television viewing (Rhodes et al., 2012). This finding is consistent with earlier work demonstrating that unemployed individuals are more sedentary and less physically active than employed individuals, although this relationship appears to vary by gender, type of employment, health status, and day of the week (Van Domelen et al., 2011). For example, women with sedentary jobs were found to be more sedentary and less active than healthy unemployed women on weekdays (Van Domelen et al., 2011).

The present study’s finding that retired/unemployed individuals are more sedentary than employed individuals is likely also partially mediated by chronic health conditions and/or age-related decline. For example, higher prevalence of coronary heart disease among men and women of Puerto Rican background and men of Cuban or Dominican background (Daviglus et al., 2012) may result in these groups accumulating more sedentary time than other groups. The finding also may reflect what is known as the “healthy worker effect,” (Li and Sung, 1999) which states that employed individuals have lower morbidity and mortality, and are generally more healthy than those not employed.

Across almost all ages and Hispanic/Latino backgrounds, women were more sedentary than men. This is different than what has been found previously among a nationally representative sample of Non-Hispanic Whites and Blacks where middle age and older women were similar to or less sedentary than their male counterparts (Matthews et al., 2008). Cultural beliefs, such as believing that occupation and family duties provide sufficient amounts of physical activity (Cromwell and Berg, 2006) or that family responsibilities come before personal health (D’Alonzo, 2012), may result in Hispanic/Latino women accumulating more leisure-based sedentary time than men.

Similar to Matthews et al. (2008), the present study found that sedentary time was not higher with successive age groups. Instead, time spent in sedentary behaviors was greater among younger (18–34) compared to middle-age (35–49) adults. However, the magnitude of this difference was small and sedentary time was higher among subsequent age groups. The observed 1.3 h/day of additional sedentary time in adults between 35–49 and 65–74 is similar to estimates found in another work (Matthews et al., 2008) and is notable when considering the concomitant declines in physical activity with age (Troiano et al., 2008). Researchers have begun to investigate how to reduce sedentariness among older adults (Corderner et al., 2012), but work has yet to be undertaken among an ethnically diverse Hispanic/Latino older adult population.

The present study did not find support for a link between overweight/obesity status and sedentary time. Whereas there is moderate support for a link between television watching/screen time and higher BMI (Thorp et al., 2011), the evidence for overall sedentary time and overweight/obesity status is weak (Rhodes et al., 2012). However, other work investigating the association between sedentariness and health in this sample found evidence that increasing time spent being sedentary is associated with cardiometabolic disease risk factors such as poor glycemic and insulin profiles (Qi et al., Kaplan R. Sedentary Behavior and Cardiometabolic Risk Factors Among US Hispanic/Latino Adults: The Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Circulation.). The negative impact of sedentary time on these risk factors remained even after adjusting for physical activity, BMI, and waist-to-hip ratio (Qi et al., Kaplan R. Sedentary Behavior and Cardiometabolic Risk Factors Among US Hispanic/Latino Adults: The Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Circulation.).

There was also no evidence of an association between marital status and sedentary time, which is in line with earlier work (Rhodes et al., 2012). Also, although other studies have found that acculturation indicators such as language use are related to activity levels among Hispanic/Latino adults (Banna et al., 2012; Murillo et al., 2014; Gaskins et al., 2012; Crespo et al., 2001), country of birth, years in the US, and language preference were not associated with sedentary time in the present study. These differences may be due to the fact that previous work was conducted predominantly among adults identifying as Mexican American (Banna et al., 2012; Murillo et al., 2014; Gaskins et al., 2012; Crespo et al., 2001) and/or that other studies assessed leisure-time physical activity (Gaskins et al., 2012; Crespo et al., 2001).
Self-reported sedentary behavior (Banna et al., 2012; Murillo et al., 2014), or only explored television viewing among women (Banna et al., 2012).

Hispanic/Latino adults in the present study spent a larger percentage of their accelerometer wear time engaged in sedentary behaviors (74%) compared to earlier studies that described the sedentariness of Whites, Blacks, and Mexican American adults (Matthews et al., 2008). This may be explained, in part, due to the prevalence of adverse health characteristics among this sample, such as cardiovascular disease risk factors (Daviglus et al., 2012), which limit mobility and/or are associated with more time spent being sedentary (Loprinzi et al., 2014). Participants in the present study were also older, and the sample size was larger than in previous work (Matthews et al., 2008). However, it is worth noting that the average monitoring period in the present study was approximately 2 h per day longer than usually observed, which must be considered when making such a comparison. Individuals spend more time being sedentary in the evening hours, which is usually when extended accelerometer wear occurs (Tudor-locke et al., 2011). Also, given that adults are sedentary for approximately half of every hour between 12 and 17 h of wear time (Tudor-locke et al., 2011), each additional hour of monitoring may increase sedentary time estimates up to 30 min.

Strengths and limitations

This study's strengths include its large, diverse sample of Hispanic/Latino adults from four major metropolitan areas in the US. This study is the first to report on objective estimates of daily sedentariness among adults from various Hispanic/Latino backgrounds, and provides evidence indicating that these populations should not be considered homogenous. The study is also bolstered by its transparency in reporting about accelerometer data treatment (Dallal et al., 2012).

Although there is some evidence that sedentariness varies between week and weekend days (Burton et al., 2012; Evenson et al., 2015), most studies using objectively derived estimates of sedentary behavior do not take day of the week into consideration in their analyses. Requiring participants to contribute at least one weekend day of wear often results in too much data loss. The present study addressed the potential difference by day of the week by weighting the observed data. Although we expect that this provides more accurate estimates of individuals' sedentariness, it could be problematic in terms of external validity. However, given that the observed difference between week-day and weekend sedentariness was small, our weighting does not likely affect comparability with other studies.

The study is limited by the unusually long wear times observed among some adults. In particular, individuals of Dominican and Puerto Rican background, who predominately were recruited from the Bronx, had estimates of daily sedentariness that were longer than their average waking day. It is possible that some of these individuals wore their devices to sleep due to misunderstandings of the study protocol and that some of their sleep time was incorrectly classified as wear time involving very low intensity activity as opposed to non-wear. Although one way to address this would have been to exclude data based on self-reported sleep at the individual-day level, we felt this carried a potentially equally problematic bias to use self-reported "usual" sleep/wake times that may not have aligned with the days that the accelerometer was worn by the participant. Instead, to address the issue of excessive wear time, we conducted a sensitivity analysis, which involved restricting the sample to only those who wore the Actical < 16 h/day (i.e., the average daily monitoring period). Although the smaller sample sizes in this restricted analysis are limited, due to the fact that Actical wear time is associated with various sociodemographic characteristics (e.g., higher household income) (Evenson et al., 2015), we recommend that the sedentary estimates derived from the restricted sample be used when making comparisons to other work given that this monitoring period more closely aligns with other studies.

Conclusions

The present study provided objective estimates of daily sedentary time among a diverse population of Hispanic/Latino adults. Adults of Mexican background were found to be the least sedentary, highlighting that individuals from different Hispanic/Latino backgrounds should not be considered a homogenous population.

In line with earlier work, being employed and having higher education was associated with more time spent being sedentary. Hispanic/Latino background may interact with type of occupation and other socioeconomic factors to influence how daily sedentary time is accumulated. Future work should explore how Hispanic/Latino adults from diverse backgrounds similarly/differently accumulate sedentary time throughout the waking day as well as how daily sedentary behavior, physical activity, and sleep varies across groups. This will assist our understanding of how interindividual variance in the movement continuum (Tremblay et al., 2010) affects health outcomes, such as diabetes, that disproportionately affect Hispanic/Latino adults residing in the US (Cowie et al., 2010).

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Conflict of interest statement

The authors declare that there are no conflicts of interest.

Transparency document

The Transparency document associated with this article can be found, in the online version.

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Appendix A

Table A1

|                  | Mexican (N = 5192) | Puerto Rican (N = 2089) | Cuban (N = 1680) | Central American (N = 1273) | Dominican (N = 1178) | South American (N = 846) | Other/multi-ethnica(N = 347) |
|------------------|--------------------|-------------------------|------------------|-----------------------------|----------------------|--------------------------|-----------------------------|
| Wear time, M (SD) | 15.4 (2.6)         | 17.6 (2.8)              | 14.5 (2.3)       | 15.5 (3.0)                  | 18.2 (2.5)           | 16.0 (2.8)                | 16.3 (3.0)                  |
| Participants with ≥20 h of wear, n (%)b | 430 (6)            | 494 (16)                | 66 (2)           | 149 (7)                     | 309 (20)             | 89 (7)                   | 59 (9)                      |
| Sleep time, M (SD) | 8.0 (1.3)          | 7.7 (1.6)               | 7.9 (1.4)        | 7.9 (1.3)                   | 7.8 (1.5)            | 7.7 (1.3)                | 7.8 (1.5)                   |
| Estimated waking dayc | 16                | 16.3                    | 16.1             | 16.1                        | 16.2                 | 16.3                     | 16.2                        |

a Other/multi-ethnic were also of Hispanic/Latino origin.
b All values are weighted for study design, calibrated using the 2010 Census population, and adjusted for Actical non-response.
c Estimated waking day is 24 h – sleep time in hours.

Table A2

| Field center | Total (N = 12,605) | Mexican (N = 5192) | Puerto Rican (N = 2089) | Cuban (N = 1680) | Central American (N = 1273) | Dominican (N = 1178) | South American (N = 846) | Other/multi-ethnic(N = 347) |
|--------------|-------------------|-------------------|-------------------------|------------------|-----------------------------|----------------------|--------------------------|-----------------------------|
| Bronx        | 3154 (25)         | 160 (8)           | 1394 (72)               | 36 (2)           | 166 (19)                    | 1110 (95)            | 152 (25)                 | 136 (42)                    |
| Chicago      | 3316 (26)         | 1595 (26)         | 598 (21)                | 21 (1)           | 342 (14)                    | 21 (0.7)             | 302 (20)                 | 73 (11)                     |
| Miami        | 2905 (23)         | 32 (1)            | 67 (5)                  | 1616 (97)        | 718 (63)                    | 45 (4)               | 355 (51)                 | 72 (27)                     |
| San Diego    | 3230 (26)         | 3041 (64)         | 30 (2)                  | 7 (0.4)          | 47 (4)                      | 2 (0.4)              | 37 (4)                   | 66 (21)                     |

All values are weighted for study design, calibrated using the 2010 Census population, and adjusted for Actical non-response.
b Other/multi-ethnic were also of Hispanic/Latino origin.
c Percentages may not sum to 100 due to rounding.

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