Physical Activity Patterns of Latina Immigrants Living in Alabama

Sarah Katherine Sweatt · Amanda L. Willig · April A. Agne ·
Jamie L. Powell · Andrea L. Cherrington

Received: 26 September 2014 / Revised: 2 December 2014 / Accepted: 5 January 2015 / Published online: 12 February 2015
© W. Montague Cobb-NMA Health Institute 2015

Abstract

Background Latinos are the fastest growing minority group in the Southeastern USA. Latinos living in the USA have a higher prevalence of obesity, metabolic diseases, and physical inactivity compared to non-Latino Whites, particularly Latina women. The objective of this study is to assess the patterns of physical activity (PA) in overweight Latina immigrants in Alabama using a self-report and an accelerometer.

Methods Participants included foreign-born Latina women age ≥ 19 years with BMI ≥ 25 kg/m². The Global Physical Activity Questionnaire was used to assess self-reported physical activity. Accelerometers were used as an objective measure of physical activity.

Results Among 44 overweight/obese Latina immigrants (mean age 36.6 years and BMI 33.3 kg/m²), 36.4 % met PA recommendations by self-report while only 20.5 % met recommendations according to the accelerometer. Self-report sedentary activity was underestimated (186 min/day self-report vs. 575 min/day accelerometer) while moderate activity was overestimated (34 min/day self-report vs. 15 min/day accelerometer). While the number of years living in the USA was positively associated with vigorous activity ($r=0.32$, $p=0.03$), the number of years living in Alabama tended to be positively associated with sedentary activity and negatively associated with moderate activity.

Conclusions Latina immigrants living in Alabama overestimated the amount of time spent in moderate PA and underestimated time spent in sedentary activity.

Keywords Accelerometry · Community-based research · Physical activity · Overweight · Health disparities

S. K. Sweatt · A. L. Willig · A. A. Agne · J. L. Powell ·
A. L. Cherrington (✉)
University of Alabama at Birmingham, Birmingham, AL, USA
e-mail: cherrington@uab.edu

Obesity is a worldwide epidemic that results from alterations in regulation of energy intake, energy expenditure, and storage [1]. Obesity is associated with an array of cardiometabolic conditions such as type 2 diabetes (T2D) [2]. In the USA, approximately 33 % of the population is obese [3] with variations in prevalence by region as well as race and ethnicity. Latinos living in the USA have a higher prevalence of obesity (38.7 %) and metabolic diseases compared to non-Hispanic Whites (32.8 %). [3–5] Latinas, in particular, are more negatively impacted with an obesity prevalence of 45.1 % compared to 35.5 % for all non-Latina women [3]. Physical inactivity is a known risk factor for obesity and diabetes [6]. Increasing the level of physical activity improves metabolic status, insulin sensitivity, and is an effective therapeutic strategy for management and prevention of obesity and T2D [7–12]. Understanding free-living physical activity patterns of Latinas could inform interventions aimed at reducing sedentary time and increasing physical activity in this vulnerable population.

The Centers for Disease Control and Prevention's 2008 Physical Activity Guidelines for Americans suggest that adults should perform at least 150 min of moderate-intensity (i.e., brisk walking) or 75 min of vigorous-intensity (i.e., jogging or running) aerobic activity every week and 2 or more days a week of muscle-strengthening activities [13]. Less than half of adults in USA meet the 2008 Physical Activity Guidelines [14]. Overall, physical activity in Latinos was previously reported to be markedly less than non-Latinos in the USA [15–20]. This changed when nationally representative samples began using an accelerometer to objectively measure physical activity. More recent studies report that Latinos are more physically active compared to non-Latinos in the USA [21, 22].

Latinos are now the largest ethnic minority population in the USA and the fastest growing minority group in the Southeastern region of the USA [23]. Seven of the states with the largest percent increase in their Latino population are found in

the Southeastern USA, where obesity rates are among the highest in the nation [23]. However, information about free-living physical activity levels of Latina women living in the USA is limited in general and is particularly absent with regard to those women living in emerging communities in the Southeast. Accelerometers are validated for physical activity measurement in Latina women, but cost and participant burden may be prohibitive [24]. The Global Physical Activity Questionnaire (GPAQ) is a self-report measure that has been validated in many populations to be a suitable assessment of physical activity and thus potentially provides a fast and affordable way to assess physical activity in community-based settings [25, 26]. The primary objective of this study was to assess the patterns of physical activity in a sample of overweight, Mexican, or Central American Latina immigrants in a Southeastern region of the USA using two methods of assessment, specifically the GPAQ as a self-report measure versus accelerometer data. In this study, we assessed patterns using each method and compared the results from each. We also evaluated the association of demographic and health parameters with physical activity in the women.

Methods

Participants

Foreign-born Latina women of at least 19 years of age with BMI ≥ 25 , not pregnant, non-diabetic were recruited through a local safety-net hospital, multicultural center, and by word-of-mouth to participate in a weight loss/diabetes prevention program, ESENCIAL Para Vivir (in English, Essential for Life). Of the 147 women approached, 74 agreed to participate. However, 15 of those women did not meet eligibility requirements (BMI < 25 , diagnosed diabetes, or taking weight loss medication). Top reasons for declining to participate included not having enough time and inflexible work hours. Baseline data used in this study were obtained during October 2010 and February 2011 prior to the program from women who wore the accelerometer for a minimum of 4 days ($n=44$). All participants provided informed consent in their native language (Spanish). A trained bilingual member of the study staff completed informed consent and administered the survey instruments and measurements. The University of Alabama at Birmingham's Institutional Review Board approved all study protocols and documents.

Height and Weight Height and weight were measured using standardized protocols. Height was measured using a portable stadiometer (Seca 217, Seca, Columbia, MD) to the nearest centimeter. Weight was measured using an electronic scale

(Health-O-Meter Professional 349KLX, Health-O-Meter, Boca Raton, FL) to the nearest 0.1 kg.

Questionnaires Surveys were administered in-person by a trained bilingual/bicultural interviewer in 45 min or less. We measured self-rated health status with the following survey question, “compared to other people your age, would you say your health is excellent, very good, good, fair or poor?” [27]. For ease of interpretability and consistent with previous research, we collapsed responses to the self-rated health question into two categories: excellent/very good/good, and fair/poor [28, 29]. The Patient Health Questionnaire (PHQ-8) was used to assess depressive symptoms [30]. The Spanish version has been previously validated and widely used to assess depressive symptoms in the US Latino population [31]. A cut-point of 10 or greater was used to indicate moderate to severe depressive symptoms. The Global Physical Activity Questionnaire (GPAQ) was used to assess self-reported physical activity. The GPAQ assesses the following three domains of physical activity by intensity (moderate or vigorous) as minutes per week during a typical week: (1) occupational physical activity, (2) physical activity for transportation (walking, biking to work), and (3) recreational or leisure-time physical activity. Finally, the GPAQ assesses time spent in non-sleep sedentary activity (watching TV, traveling in a car, etc.). Minutes spent in moderate, vigorous, and sedentary intensities were summed. The GPAQ has been used in a number of different countries, including among Latinos living in the USA [26, 25].

Accelerometer Participants wore an MTI Actigraph accelerometer (GT1M, ActiGraph Health Services, Pensacola, FL) for 4 days (3 weekdays and 1 weekend day) to objectively measure physical activity levels. Epoch length was set at 1 min, and results were expressed as counts per minute (counts/min⁻¹). Monitors were worn on an elastic belt at the waist over the right hip, with removal only occurring during activities such as sleeping, bathing, and swimming. Actigraph monitors have been shown to exhibit a high degree of inter-instrument reliability [24]. Outcome measures included time spent in four intensities of physical activity: non-sleep sedentary, light, moderate, and vigorous activity.

Statistical Analysis

Descriptive statistics were tabulated as the mean (SD) or number (%). The association between accelerometer data and the GPAQ for minutes per day of sedentary and active categories was analyzed with nonparametric Spearman partial correlations adjusting for age and BMI. Analysis of variance with Tukey's post hoc test

was utilized to compare mean accelerometer and GPAQ data between overweight (BMI 25–29.9), obese class I (BMI 30–34.9), and obese class II (BMI ≥ 35) participants. Unadjusted Spearman correlations were used to determine which population characteristics were associated with sedentary time, moderate and vigorous physical activity as measured by the accelerometer. All analyses were conducted using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA) with a significance level of $p < 0.05$ (Fig. 1).

Results

Characteristics of the sample are shown in Table 1 as mean $\pm$ standard deviation or as proportions. Participants included 44 overweight and obese Latina immigrants age 36.6 ± 7.8 years with BMI 33.3 ± 5.2 ; 83.3 % of the sample were immigrants from Mexico. Average years in the USA were 12.8 ± 6.1 years, and average years in Alabama was 9.4 ± 5.3 years. Fifty percent of the sample was unemployed. Of the 16 women who completed their education at high school or a higher level, 2 were college graduates. According to self-report, 36.4 % of the sample

met physical activity recommendations while only 20.5 % met recommendations according to the accelerometer.

GPAQ and Accelerometer Data

Mean and standard deviations for minutes per week of physical activity by self-report determined by the GPAQ and by the accelerometer are shown in Table 2. On average, women underestimated sedentary/sitting time and time spent in vigorous activity, but reported more time spent in moderate activity as compared to accelerometer estimates. Self-report and accelerometer data for sedentary time ($r = 0.06$; $p = 0.68$), moderate activity ($r = 0.08$; $p = 0.61$), and vigorous activity ($r = -0.04$; $p = 0.79$) were not significantly correlated. Models adjusted for age and BMI yielded similar results for sedentary time ($r = 0.07$; $p = 0.67$), moderate activity ($r = 0.08$; $p = 0.61$), and vigorous activity ($r = 0.01$; $p = 0.94$) (Fig. 1).

Physical Activity Measure by BMI Category

We examined physical activity measure by BMI category to determine whether self-report and accelerometer

Fig. 1 Spearman correlation between self-report minutes of physical activity (GPAQ) and accelerometer-determined minutes among Latina participants in ESENCIAL Para Vivir pilot intervention. Data adjusted for age and body mass index

Table 1 Demographic characteristics of Latina participants in the ESENCIAL Para Vivir pilot intervention in Alabama, 2010–2011 ($n=44$)

Sample characteristics	Mean (SD) or percent (n)
Age (years), mean (SD), [range]	36.6 (7.8) [24–59]
Education, percent (n)	
<High school	63.7 % (28)
≥High school	36.3 % (16)
Marital status, percent (n)	
Single	15.9 % (7)
Married/living as married	84.1 % (37)
Number of children	
0	4.5 % (2)
1	4.5 % (2)
2	29.6 % (13)
3	34.1 % (15)
4	18.2 % (8)
5	6.8 % (3)
6	2.3 % (1)
Employment, percent (n)	
Full-time	15.9 % (7)
Part-time	34.1 % (15)
Unemployed	11.4 % (5)
Housewife	38.6 % (17)
Health insurance, percent insured (n)	13.6 % (6)
Country of origin, percent (n)	
Mexico	84.1 % (37)
Central America	15.9 % (7)
Years in the USA, mean (SD), [range]	12.8 (6.1), [3–31]
Years in AL, mean (SD), [range]	9.4 (5.3), [0.25–23]
Mean BMI (SD), [range]	33.3 (5.2), [26–48]
Weight status (BMI)	
Overweight (25–29.9)	29.5 % (13)
Obese I (30–34.9)	45.5 % (20)
Obese II (≥35)	25.0 % (11)
Provider recommended weight loss, percent yes (n)	59.1 % (26)
Met current PA recommendations, percent (n) ^a	
Accelerometer	20.5 % (9)
Self-report	36.4 % (16)

^a Participants met or exceeded the CDC's 2008 PA guidelines for 150 min of moderate intensity or 75 min of vigorous intensity per week

physical activity differed by BMI (Table 2). BMI category (overweight, obese class I, obese class II) was not associated with differences in self-report versus accelerometer physical activity and sedentary time. When comparing accelerometer results only between the groups, women in obese class I were more active than overweight women ($p<0.01$). Obese class I women also

had less sedentary time compared to overweight women, though this was not significantly different ($p=0.07$).

Relationship Between PA Measures and Demographic and Health Factors

Table 3 shows sociodemographic and health-related factors associated with minutes per day spent in sedentary, light, moderate, and vigorous activity as measured by the accelerometer. Years lived in the USA was positively associated with vigorous activity (0.32; $p=0.03$). There was a trend with more years in the USA associated with greater moderate activity and less light activity. There was a positive trend for years lived in Alabama and sedentary time and an inverse trend for moderate activity. These results suggest that the more years lived in the USA, the more moderate and vigorous activity the Latina women did. However, the more time lived in Alabama, they were more likely to be sedentary and do less moderate activity. Full- or part-time employment was associated with decreased sedentary time and a trend for increased light activity. The health comparison was inversely associated with vigorous activity, and there was a trend for moderate activity, suggesting feeling good to excellent is related to less vigorous and less moderate activity.

Discussion

This study is the first of which we are aware to evaluate physical activity patterns in overweight Latina immigrants living in Alabama using two validated methods, the GPAQ evaluating perceived physical activity and the accelerometer capturing actual physical activity. In this sample of overweight and obese Latina immigrants, approximately one in five meet current US guidelines for physical activity. According to the accelerometer, Latinas were very sedentary, averaging 575 min/week (9.6 h/day) that accounted for approximately 69 % of waking time. In addition, women reported a high amount of sedentary time by self-report (GPAQ); however, they still underestimated the extent to which they were sedentary. The women estimated about 3–4 h of sitting time, when they are actually sedentary 9–10 h according to the accelerometer.

Our results indicated that Latinas overestimated time spent in moderate and vigorous physical activity according to the GPAQ. The GPAQ was developed in 2002 under the World Health Organization (WHO) during the WHO STEPwise Approach to Chronic Disease Risk Factor Surveillance (STEPS) [25]. It has been validated in many countries as an acceptable method of assessing physical activity patterns among adults [25]. The inaccuracy in self-report of moderate physical activity of women in our study may be due to a disconnect in perception of intensity and/or time spent in physical activity. Inaccuracy in perception of physical activity may be an

Table 2 Self-reported minutes of physical activity (GPAQ) and accelerometer-determined minutes of activity per day categorized by activity type and obesity category among Latina participants in ESENCIAL Para Vivir pilot intervention ($n=44$)

	Sedentary		Moderate		Vigorous	
	Self-report	Accelerometer	Self-report	Accelerometer	Self-report	Accelerometer
All participants ($n=44$)	186.14 (105.04)	575.46 (93.67)	34.40 (54.62)	15.33 (14.23)	2.91 (11.04)	8.28 (37.30)
Overweight BMI ≥ 25 –29.9 ($n=13$)	205.4 (108.8)	620.6 (95.8)	74.2 (92.2)	8.2 (8.5)	28.5 (99.7)	0 (0)
Obese I BMI 30–34.9 ($n=20$)	177.0 (115.9)	544.8 (97.6)	77.3 (115.7)	22.2 (16.1)	25.6 (47.6)	18.2 (54.4)
Obese II BMI ≥ 35 ($n=11$)	180.0 (115.9)	577.8 (63.7)	47.7 (115.7)	11.3 (10.7)	0 (0)	0 (0)

important consideration because those who perceive activity as harder than it actually is may be less likely to engage in physical activity, even when increased physical activity is prescribed. In addition, participation in physical activity may be influenced by body weight and fitness status. For example, a study by Hoos et al. concluded that the GPAQ accurately estimated physical activity in *non-obese* Latina women living in California [26]. However, the women in our study were *all* overweight or obese; therefore, weight may influence perception of, or likelihood to participate in physical activity.

A study by Aadahl et al. investigated the association between self-rated physical fitness and perceived exertion of 42 types of physical activities. Their findings indicated that self-rated physical fitness was negatively related to the rating of perceived exertion of specific activities [32]. Therefore, a fit individual may perceive moderate-intensity activities to be

truly moderate, while unfit individuals may perceive light-intensity occupational, transportation, and leisure-time physical activities as moderate intensity. Importantly, the GPAQ asks about amount of time spent sitting and in moderate activity however skips time spent in light activity. Therefore, while women in our study may have perceived light-intensity physical activity as moderate, we are not able to determine whether that is true. This may have contributed to the discrepancy between the GPAQ and accelerometer data. Consequently, the questionnaire on average may only capture about 6 h worth of daytime activity while the accelerometer is measuring about 12–15 h.

The finding that self-rated health (SRH) was inversely associated with vigorous and moderate physical activity was unexpected and somewhat contradicts previous findings from our own group and others linking higher levels of physical activity with better perceived health [33, 34]. In a study by Kepka et al. among Latinos living in North Carolina, SRH was positively associated with higher levels of self-reported leisure-time physical activity [33]. In the current study, women who reported fair to poor perceived health were more likely to engage in moderate to vigorous activity as measured by the accelerometer. It is possible that this association relates to environmental exposure. In a study by Parkes et al., individuals in active or strenuous jobs reported lower SRH [34]. Thus, it is conceivable that women in this study who reported lower SRH were engaged in physically demanding jobs. However, the small sample size in this study prohibited additional analyses examining sub-groups and limits our ability to generalize. Future larger studies are needed to confirm these findings and tease apart the etiology as it relates to leisure time versus occupational physical activity.

Sedentary behavior is defined as activities eliciting an energy expenditure less than 1.5 times resting energy expenditure, such as sitting, reclining, and lying down during waking hours [35]. Importantly, sedentary behavior is associated with increased risk of obesity, cardiovascular disease, cognitive impairment, metabolic syndrome, and diabetes [36, 37]. Koster et al. used the National Health and Nutrition Examination Survey (NHANES) accelerometer data and reported that women over 50 years who spend more than 70.5 % of time in

Table 3 Correlation [R (p value)] between demographic/health factors and accelerometer-measured physical activity type among Latina participants in ESENCIAL Para Vivir pilot intervention ($n=44$)

Demographic/health factor	Activity type			
	Sedentary	Light	Moderate	Vigorous
Years in the USA	0.10 (0.52)	−0.29 (0.06) ^a	0.28 (0.06) ^a	0.32 (0.03)
Years in AL	0.28 (0.06) ^a	−0.17 (0.26)	−0.28 (0.06) ^a	−0.20 (0.18)
Age	−0.22 (0.15)	0.16 (0.28)	0.05 (0.76)	0.15 (0.32)
BMI	−0.03 (0.03)	0.08 (0.62)	0.01 (0.93)	−0.10 (0.51)
Depression	−0.22 (0.14)	0.14 (0.35)	0.14 (0.36)	0.19 (0.22)
Education	0.20 (0.18)	−0.16 (0.31)	−0.06 (0.72)	−0.04 (0.81)
Employed	−0.34 (0.02)	0.27 (0.07) ^a	0.04 (0.78)	−0.11 (0.49)
Self-reported health	0.16 (0.31)	0.01 (0.97)	−0.28 (0.06) ^a	−0.34 (0.02)

Bold entries indicate significant association

^a Indicates trend for significance

sedentary behavior had a five times greater risk of death compared to those who were less sedentary [38]. In comparison, Latina women in our study spent a close 69 % of waking time in sedentary behavior. Increased sedentary time prior to age 50 years may increase mortality above that reported by Koster et al. [38]. Our data reveal a lack of awareness regarding the extent of sedentary behavior among the women in our study and underscore the importance of promoting strategies aimed at decreasing sedentary time and increasing physical activity among Latina immigrants. Devices that provide feedback, such as pedometers, may heighten awareness of sedentary behavior and facilitate goal-setting behaviors for physical activity in this population.

Studies have shown a positive correlation between time spent in the USA and increased physical activity among Latino immigrants. Matthews et al. assessed overall activity in a nationally represented sample and found that Mexican-American adults were less sedentary than both non-Hispanic Whites and Blacks [21]. Mexican-American women age 20–39 years spent 6.75 h per day sedentary, which was less sedentary than non-Hispanic Whites and Blacks spending 7.49 and 7.8 h/day engaged in sedentary behavior, respectively [21]. In a similar study, Hawkins et al. reported that Hispanic women that were US residents age 40–59 years were more active than White and Black counterparts due to increased light physical activity [22]. This may be due to increased occupational physical activity as Latina immigrants commonly have non-sedentary jobs. Using the NHANES 2003–2004, Gay and Buchner reported Mexican-Americans with active occupations spent more time in light-intensity physical activity and less time engaged in sedentary activity compared to non-Hispanic White and Black adults [39]. In our cohort, 50 % were employed while 11 % were unemployed and 39 % were homemakers. We found an association between employment (full and part time) and decreased sedentary behavior and a trend for increased light activity. This suggests that those who are employed may spend less time sedentary, and instead spend that amount of time in light activity [40]. In agreement with previous studies [21, 22], we found time spent in the USA was associated with increased light, moderate, and vigorous activity by accelerometer. Interestingly though, years spent in Alabama was associated with increased sedentary time and decreased moderate physical activity. Our data are not surprising as Alabama and the Southeast region of the USA have a high prevalence of physical inactivity, obesity, and cardiometabolic disease [41]. According to the Centers for Disease and Prevention (CDC) and the self-report Behavioral Risk Factor Surveillance System (BRFSS), Alabama has a high incidence of overweight and obesity compared to other states in the USA. With 69 % of

Alabamians overweight and 33 % obese, Alabama ranks 4th in obesity among the 50 states according to BRFSS and 14th according to the REasons for Geographic And Racial Differences in Stroke (REGARDS) study that directly measured BMI [42–44]. In 2010, Alabama had the highest percentage of US adults with diagnosed diabetes and prediabetes by state according to the CDC with 11.1 and 7 %, respectively [45]. Lifestyle behaviors are heavily influenced by socioeconomic, cultural, and contextual factors [46]. Physical activity patterns and dietary habits may be influenced as Latinas acculturate to attitudes, values, and behaviors typical of Alabama [47].

Our data suggest that patterns of physical activity among Latinos living in the USA should be examined by region before generalizations about trends related to length of stay in the USA are made. Further investigation of lifestyle factors that contribute to sedentary behavior among Latina immigrants in Alabama and areas in the southeast region of the USA is needed.

This study has several limitations. The study included a convenience sample of volunteers; therefore, generalizability of the findings are limited. In addition, the sample size was small and volunteers were overweight and obese further limiting generalizability. Our findings do however support future research evaluating physical activity patterns and validating self-report measures in Latina immigrants living in the southeastern region of the USA as there is a lack of research in current literature in this population. The accelerometer does not capture upper body movement that may have biased the assessment of the objective physical activity measure. Also, the current study provides estimates of physical activity patterns reported by average minutes per day that are influenced by both weekend days and weekdays. This is a potential limitation as patterns of behavior may vary on these days. Results of this study should be interpreted accordingly.

In summary, overweight and obese Latina immigrants living in Alabama are markedly more sedentary compared to national averages for women the same age. They overestimated the amount of time spent in moderate physical activity and underestimated time spent in sedentary activity suggesting that the GPAQ may not accurately reflect physical activity in this population. The disconnect between self-report of physical activity and actual physical activity as measured by the accelerometer suggests women may not be aware of the amount of time they spend active as compared to sedentary. A physical activity monitoring device, such as a pedometer, with a daily number of steps or activity level goal could provide women a simple self-assessment tool to increase awareness of and participation in physical activity. Future studies are needed to examine the extent to which self-monitoring

could improve physical activity levels among Latinas living in emerging communities.

Acknowledgements This work supported in part by grants from the Robert Wood Johnson Physician Faculty Scholars' Program [047948], and the National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, the University of Alabama Birmingham Diabetes Research Center [P30 DK079626]. Other support was provided by Award Number P30DK056336 from the National Institute Of Diabetes And Digestive And Kidney Diseases. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute Of Diabetes And Digestive And Kidney Diseases or the National Institutes of Health.

Conflict of Interest The authors declare they have no conflict of interest.

Ethics The University of Alabama at Birmingham and Cooper Green Mercy Health System's Institutional Review Boards approved this study. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study. No identifying information about participants is included in the article.

References

- Bleich S, Cutler D, Murray C, Adams A. Why is the developed world obese? *Annu Rev Public Health*. 2008;29:273–95. doi:10.1146/annurev.publhealth.29.020907.090954.
- de Vries J. The obesity epidemic: medical and ethical considerations. *Sci Eng Ethics*. 2007;13(1):55–67.
- Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999–2008. *JAMA*. 2010;303(3):235–41. doi:10.1001/jama.2009.2014.
- Carter JS, Pugh JA, Monterrosa A. Non-insulin-dependent diabetes mellitus in minorities in the United States. *Ann Intern Med*. 1996;125(3):221–32.
- Sundquist J, Malmstrom M, Johansson SE. Cardiovascular risk factors and the neighbourhood environment: a multilevel analysis. *Int J Epidemiol*. 1999;28(5):841–5.
- Knight JA. Physical inactivity: associated diseases and disorders. *Ann Clin Lab Sci*. 2012;42(3):320–37.
- Sallis JF, Kraft K, Linton LS. How the environment shapes physical activity: a transdisciplinary research agenda. *Am J Prev Med*. 2002;22(3):208.
- Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. *JAMA J Am Med Assoc*. 2001;286(10):1195–200.
- Chaput JP, Klingenberg L, Rosenkilde M, Gilbert JA, Tremblay A, Sjodin A. Physical activity plays an important role in body weight regulation. *J Obes*. 2011. doi:10.1155/2011/360257.
- Hunter GR, Brock DW, Byrne NM, Chandler-Laney PC, Del Corral P, Gower BA. Exercise training prevents regain of visceral fat for 1 year following weight loss. *Obesity*. 2010;18(4):690–5. doi:10.1038/oby.2009.316.
- Lindstrom J, Ilanne-Parikka P, Peltonen M, Aunola S, Eriksson JG, Hemio K, et al. Sustained reduction in the incidence of type 2 diabetes by lifestyle intervention: follow-up of the Finnish Diabetes Prevention Study. *Lancet*. 2006;368(9548):1673–9. doi:10.1016/S0140-6736(06)9701-8.
- Bassuk SS, Manson JE. Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease. *J Appl Physiol*. 2005;99(3):1193–204. doi:10.1152/japplphysiol.00160.2005.
- Services USDoHaH. 2008 Physical activity guidelines for Americans. In: Services USDoHaH, editor. Hyattsville, MD U.S. Department of Health and Human Services; 2008.
- Carlson SA, Fulton JE, Schoenborn CA, Loustalot F. Trend and prevalence estimates based on the 2008 physical activity guidelines for Americans. *Am J Prev Med*. 2010;39(4):305–13. doi:10.1016/j.amepre.2010.06.006.
- Macera CA, Ham SA, Yore MM, Jones DA, Ainsworth BE, Kimsey CD, et al. Prevalence of physical activity in the United States: behavioral risk factor surveillance system, 2001. *Prevent Chronic Dis*. 2005;2(2):A17.
- Crespo CJ, Smit E, Carter-Pokras O, Andersen R. Acculturation and leisure-time physical inactivity in Mexican American adults: results from NHANES III, 1988–1994. *Am J Public Health*. 2001;91(8):1254–7.
- From the Centers for Disease Control and Prevention. Prevalence of leisure-time physical activity among overweight adults—United States, 1998. In: *JAMA*. 2000. <http://www.ncbi.nlm.nih.gov/pubmed/10847806>. Accessed 20 283.
- Crespo CJ, Smit E, Andersen RE, Carter-Pokras O, Ainsworth BE. Race/ethnicity, social class and their relation to physical inactivity during leisure time: results from the Third National Health and Nutrition Examination Survey, 1988–1994. *Am J Prev Med*. 2000;18(1):46–53.
- Jones DA, Ainsworth BE, Croft JB, Macera CA, Lloyd EE, Yusuf HR. Moderate leisure-time physical activity: who is meeting the public health recommendations? A national cross-sectional study. *Arch Fam Med*. 1998;7(3):285–9.
- Winkleby MA, Kraemer HC, Ahn DK, Varady AN. Ethnic and socioeconomic differences in cardiovascular disease risk factors: findings for women from the Third National Health and Nutrition Examination Survey, 1988–1994. *JAMA J Am Med Assoc*. 1998;280(4):356–62.
- Matthews CE, Chen KY, Freedson PS, Buchowski MS, Beech BM, Pate RR, et al. Amount of time spent in sedentary behaviors in the United States, 2003–2004. *Am J Epidemiol*. 2008;167(7):875–81. doi:10.1093/aje/kwm390.
- Hawkins MS, Storti KL, Richardson CR, King WC, Strath SJ, Holleman RG, et al. Objectively measured physical activity of USA adults by sex, age, and racial/ethnic groups: a cross-sectional study. *Int J Behav Nutr Phys Act*. 2009;6:31. doi:10.1186/1479-5868-6-31.
- Passell JS CD, Lopez MH. Census 2010: 50 Million Latinos Hispanics account for more than half of nation's growth in past decade: Pew hispanic Center2011.
- Trost SG, McIver KI, Pate RR, Pate RR. Conducting accelerometer-based activity assessments in field-based research. (0195–9131 (Print)).
- Bull FC, Maslin TS, Armstrong T. Global physical activity questionnaire (GPAQ): nine country reliability and validity study. *J Phys Act Health*. 2009;6(6):790–804.
- Hoos T, Espinoza N, Marshall S, Arredondo EM. Validity of the global physical activity questionnaire (GPAQ) in adult Latinas. *J Phys Act Health*. 2012;9(5):698–705.
- Shi L, Green LH, Kazakova S. Primary care experience and racial disparities in self-reported health status. *J Am Board Fam Pract*. 2004;17(6):443–52.
- Finch BK, Hummer RA, Reindl M, Vega WA. Validity of self-rated health among Latino(a)s. *Am J Epidemiol*. 2002;155(8):755–9.
- Finch BK, Vega WA. Acculturation stress, social support, and self-rated health among Latinos in California. *J Immigr Health*. 2003;5(3):109.
- Kroenke K, Strine TW, Spitzer RL, Williams JB, Berry JT, Mokdad AH. The PHQ-8 as a measure of current depression in the general population. *J Affect Disord*. 2009;114(1–3):163–73. doi:10.1016/j.jad.2008.06.026.
- Reuland DS, Cherrington A, Watkins GS, Bradford DW, Blanco RA, Gaynes BN. Diagnostic accuracy of Spanish language depression-screening instruments. *Ann Fam Med*. 2009;7(5):455–62. doi:10.1370/afm.981.

32. Aadahl M, Kjaer M, Jorgensen T. Perceived exertion of physical activity: negative association with self-rated fitness. *Scandinavian J Public Health*. 2007;35(4):403–9. doi:10.1080/14034940601181421.
33. Kepka D, Ayala GX, Cherrington A. Do Latino immigrants link self-rated health with BMI and health behaviors? *Am J Health Behav*. 2007;31(5):535–44.
34. Parkes KR. Physical activity and self-rated health: interactive effects of activity in work and leisure domains. *Br J Health Psychol*. 2006;11(Pt 3):533–50. doi:10.1348/135910705X59951.
35. Services USDoHaH. Physical Activity Guidelines Advisory Committee final report. In: Services USDoHaH, editor.
36. Leon-Latre M, Moreno-Franco B, Andres-Esteban EM, Ledesma M, Laclaustra M, Alcalde V, et al. Sedentary lifestyle and its relation to cardiovascular risk factors, insulin resistance and inflammatory profile. *Rev Esp Cardiol*. 2014. doi:10.1016/j.recsep.2013.10.017.
37. Alosco ML, Spitznagel MB, Cohen R, Raz N, Sweet LH, Josephson R, et al. Decreased physical activity predicts cognitive dysfunction and reduced cerebral blood flow in heart failure. *J Neurol Sci*. 2014. doi:10.1016/j.jns.2014.02.008.
38. Koster A, Caserotti P, Patel KV, Matthews CE, Berrigan D, Van Domelen DR, et al. Association of sedentary time with mortality independent of moderate to vigorous physical activity. *PLoS One*. 2012;7(6):e37696. doi:10.1371/journal.pone.0037696.
39. Gay JL, Buchner DM. Ethnic disparities in objectively measured physical activity may be due to occupational activity. *Prev Med*. 2014. doi:10.1016/j.ypmed.2014.02.015.
40. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008;40(1):181–8. doi:10.1249/mss.0b013e31815a51b3.
41. Behavioral risk factor surveillance system: prevalence and trend data—overweight and obesity, U.S. Obesity trends, trends by state 2010., (2010).
42. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—the evidence report. National Institutes of Health. Obesity research. 1998;6 Suppl 2:51S–209S.
43. Le A, Judd SE, Allison DB, Oza-Frank R, Affuso O, Safford MM, et al. The geographic distribution of obesity in the US and the potential regional differences in misreporting of obesity. *Obesity (Silver Spring)*. 2014;22(1):300–6. doi:10.1002/oby.20451.
44. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA*. 2014;311(8):806–14. doi:10.1001/jama.2014.732.
45. Overweight and obesity: adult obesity facts. Centers for Disease Control and Prevention 2014. <http://www.cdc.gov/obesity/data/adult.html>. Accessed 6/17/14 2012.
46. Candib LM. Obesity and diabetes in vulnerable populations: reflection on proximal and distal causes. *Ann Fam Med*. 2007;5(6):547–56. doi:10.1370/afm.754.
47. Abraido-Lanza AF WK, Vasques E. Immigrant populations and health. In: N. A, editor. *Encyclopedia of health and behavior*. Newbury Park, CA: Sage; 2004. p. 533–7.