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Income, physical activity, sedentary behavior, and the 'weekend warrior' among U.S. adults

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ABSTRACT

The present study examines the association between income and physical activity intensity along the entire continuum using accelerometry in a nationally representative sample of U.S. adults. Specifically, we assessed the relationship between annual household income, sedentary behavior, light, and moderate-vigorous intensity physical activity, and meeting physical activity guidelines over a brief, 2-day period ('weekend warrior'), and during the entire week. The sample consisted of 5206 National Health and Examination Survey adult participants (2003–2006) who wore accelerometers and completed pertinent survey questions. Ordinary Least Square models were computed to examine the relationship between income and the dependent variables (sedentary behavior, light, and moderate to vigorous intensity activity) adjusting for covariates. Logistic regression was employed to examine the association between income and meeting physical activity guidelines during a 2-day and 7-day time-period. Results indicate that individuals with an annual income of ≥$75,000 engaged in 4.6 more daily minutes of moderate to vigorous activity (p-value < 0.01), in comparison to the reference group (<$20,000 annual income). Those in the high-income strata were 1.6 and 1.9 times more likely to meet physical activity guidelines during a 2 and 7-day period (respectively) than their lower income counterparts ($p < 0.05$ for both). Further, those in the high-income strata spent 11.8 more minutes daily being sedentary than their lower income counterparts (p-value < 0.01). In conclusion, higher annual household income is related to more intense, less frequent (per week) patterns of physical activity and more daily sedentary time.

1. Introduction

Thirty-one percent of the population worldwide does not meet physically activity guidelines (Kohl et al., 2012). This holds true despite the fact that ample evidence from large observational studies and randomized controlled trials has established a causal link between physical activity and reduced risk for type 2 diabetes, metabolic syndrome, hypertension, some cancers, and depression (Physical Activity Guidelines Advisory Committee, 2008; U.S. Department of Health and Human Services, 1996). Worldwide, physical inactivity was estimated to lead to $53.8 billion in type 2 diabetes, breast and colon cancer, and stroke in 2013 (Ding et al., 2016). Moreover, it should be noted that evidence has accumulated in recent years pertaining to the harmful effects of prolonged sedentary behavior on health, irrespective of protective effects of physical activity (Healy et al., 2007; Owen et al., 2010). To this end, some guidelines have suggested that in addition to engaging in health promoting physical activity, individuals should strive to reduce overall and/or prolonged bouts of sitting time (Kushi et al., 2012).

Numerous barriers have been reported for not engaging in physical activity, including time, income, self-efficacy, social support, and the physical environment (Sallis et al., 2006). Of these, low income and lack of time are prominent impediments (Shuval et al., 2013). Indeed, individuals with low incomes, due to time constraints and other barriers, such as lack of exercise facilities, parks and open space, as well as an inflexible work environment (Siddiqi et al., 2011) are less likely to meet physical activity guidelines than their higher income counterparts (Parks et al., 2003). In comparison, higher income individuals similarly have limited time (e.g., due to a demanding job), but more resources and places to exercise, which could facilitate their ability to meet activity guidelines. Parks et al. (2003) found that suburban high income individuals are more than twice as likely to meet physical activity guidelines than rural low income individuals, but conclude that income appears to be more important than the area of residence as a predictor of engaging in physical activity. However, the underlying mechanistic relationship between income and physical activity is not well understood. Hence seeking a more in depth understanding of

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why higher income individuals are more active, could benefit low income individuals, as well.

From an economic perspective, Cawley (2004) posits that physical inactivity should be examined by how individuals use their scarce resources of time and money to maximize utility. He argues that this will provide an accurate explanation for why individuals are insufficiently active. For example, due to round-the-clock time constraints individuals need to choose how to allocate their scare resources, such as deciding between TV watching or exercise. This approach is consistent with Becker's investment in human capital theory, which was later adapted to health by Grossman, where individuals are producers and consumers of health (Becker, 1975; Fuchs, 1982; Grossman, 1999). Meltzer and Jena (2010) utilized a similar model to examine whether increased income leads individuals to spend less time exercising on the one hand while engaging in more intensive exercise on the other. Whereas in Grossman's model, higher education leads to more efficiency with regard to health production (Grossman, 1999), Meltzer and Jena (2010) found that higher income leads to more efficiency pertaining to exercise; that is, the higher the income the more individuals exercise with more intensity, which requires less investment of time.

Unfortunately, the Meltzer and Jena (2010) study relied on self-reported physical activity, which might be prone to recall-bias and incomplete ascertainment of physical activity across domains (i.e. leisure-time only) and intensity levels (Cerin et al., 2016; Prince et al., 2008). In fact, numerous studies have found discrepancies between self-reported physical activity and objective assessment (Prince et al., 2008). Therefore, in the current study we utilize technological advancements in the field to quantify physical activity behavior more accurately using accelerometers. Thus, we aim to examine how individuals allocate their time in each of these (in)activity intensity levels in relation to income levels among U.S. adults. Furthermore, we assess the relationship between income and physical activity patterns over the week (i.e. 'weekend warrior'). In addition, we explore the relationship between income, sedentary behavior, and light intensity activity, which has yet to be examined.

2. Methods

2.1. Data and sample

The National Health and Examination Survey (NHANES), utilized in the current study, is a population based cross-sectional study that combines self-reported data pertaining to health behaviors and outcomes alongside information gleaned from physical examinations (Centers for Disease Control and Prevention, n.d.-a). NHANES aims to determine the nutrition and health status of children and adults in the U.S.·(Shuval et al., 2015). In the present study we examine participants from two NHANES waves (2003–2004 and 2005–2006) since these two cycles are the only ones with currently available objective measurement of the ambulatory movement. Specifically, of 19,593 examined in the two cycles, a total of 9933 observations (50.7%) had potentially relevant accelerometer and survey response data. Of these 8467 were adults 18 years and above and not pregnant. A total of 1350 observations were excluded due to missing covariates and an additional 1911 observations were omitted because of insufficient accelerometer information. In the end this yielded an analytic sample of 5206 observations. This analysis of de-identified, publicly available data, did not require IRB approval.

2.2. Measures

The primary independent variable was annual household income. Specifically, income was grouped into the following categories, consistent with previous research (Meltzer and Jena, 2010) based on participants' responses to a survey question pertaining to their household income: (1) <\$20,000; (2) \$20,000–\$44,999; (3) \$45,000–\$74,999; and (4) ≥\$75,000. The primary dependent variables were physical activity and sedentary time as measured via the Actigraph 7164 accelerometers. The accelerometers measure the intensity of uniaxial movement, and data is stored within the accelerometer at intervals of one minute differences, also referred to as 'epoch' intervals (Centers for Disease Control and Prevention, 2016b). Study participants, who were ambulatory without lower limb restrictions (e.g. wheelchair users) were instructed to wear the accelerometers, for 7 consecutive days during waking hours except when swimming or bathing, on the right hip using an elastic band (Centers for Disease Control and Prevention, 2016b). Participants then returned the accelerometers in a pre-paid envelope to the NHANES study team where accelerometer data were downloaded and prepared for processing (Matthews et al., 2008; Shuval et al., 2015). In the current study, accelerometer data was downloaded from the National Center for Health Statistics website. We then used SAS programs and code, elaborated elsewhere (National Cancer Institute, 2017) provided by the National Cancer Institute to process the accelerometer data. Data were considered valid if accelerometers were worn for at least 4 days for 10 or more hours daily (Shuval et al., 2015; Troiano et al., 2008). Established cut-off points were used to determine (in)activity intensity levels (Freedson et al., 1998). Specifically, <100 counts per minute (cpm) were regarded as sedentary time, 100–1951 cpm were considered light intensity activity, and ≥1952 cpm were regarded as moderate to vigorous intensity physical activity (MVPA) (Freedson et al., 1998). We examined the relationship between income and each intensity level (i.e. sedentary time, light, and MVPA) since all are independently related to health outcomes (Healy et al., 2007; Matthews et al., 2012; Physical Activity Guidelines Advisory Committee, 2008). Moreover, we examined bouts of MVPA as an additional dependent variable. Bouts of MVPA refer to continuous activity for at least 10 min, which is indicative of planned activity or exercise (e.g. running on a treadmill) (Haskell et al., 2007). Moreover, meeting physical activity guidelines (i.e. ≥150 min of MVPA accumulated physical activity per week) during a brief period of time was examined as an additional dependent variable. We examined meeting physical activity guidelines during a 2-day period, which is consistent with a study by Lee et al. (2004) on the 'weekend warrior' effect.

2.2.1. Covariates

Covariates included participants' gender, age (18–39.9, 40–59.9, ≥60 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, other), marital status (married, widowed, divorced/separated, never married), educational attainment (<high school, high school, some college/associate, ≥college), and household size (continuous). Additional covariates were participants' health status (poor, fair, good, very good, excellent), and body mass index (BMI). BMI was determined using the standard formula (weight/height^2) based on measured weight (kg) and height (m), and grouped based on the World Health Organization suggested categorization: underweight (BMI < 18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2) and obese (≥30 kg/m^2) (World Health Organization, 2013).

2.3. Statistical analysis

Ordinary Least Square (OLS) models were estimated to examine the relationship between annual household income and the dependent variables (sedentary behavior, light, and MVPA). A separate multivariate model was constructed for each dependent variable. These models adjusted for all covariates in model 1, model 2 adjusted for all covariates in model 1 as well as accelerometer wear time, and model 3 adjusted for all covariates in model 2 plus total physical activity, which is comprised of light and MVPA. Controlling for accelerometer wear time is necessary to account for differences in participants' actual use of accelerometers during waking hours, which is essential to accurately determine levels of physical activity. Moreover, additionally adjusting for total physical activity enables determining whether participants with higher incomes levels engage in higher intensity activity out of the total physical activity performed. The same approach was taken when examining the relationship between income and sedentary time, with the exception that model 3 adjusted for MVPA and not light intensity activity due to the collinearity between light intensity activity and sedentary time.

Further, we computed OLS models to assess the relationship between income and 'structured' physical activity, that is, bouts of MVPA. Since the distribution of bouts of activity was positively skewed we used a logarithmic transformation for this variable. However, since 55.2% of participants showed no bouts of MVPA, we employed a two-part model and computed marginal effects (Madden, 2008; Mullahy, 1998). Whereas the first part of the two-part model depicts the probability of having non-zero bouted minutes, the second step runs the least squares regression on covariates while integrating the systematic error term. Thus, the marginal effects are the predicted effects of income on bouted minutes of MVPA. In addition, multivariate logistic regression was employed to examine the association between income and 2 separate dichotomous dependent variables; namely, meeting guidelines during a 2-day and 7-day time-period (yes/no). We used the same approach pertaining to adjusting for covariates in Models 1 through 3 as described above for the OLS models. Analyses were conducted using Stata version 14, and appropriate survey weights were utilized to account for the complex sampling design of NHANES·(Nguyen et al., 2017).

3. Results

The characteristics of study participants are depicted in Table 1. Briefly, less than half (47.9%) were women, and the mean age of participants was 51.7 years (SE = 18.58). A total of 48.1% had some or complete college education, and 78.6% reported good, very good or excellent health. Moreover, 21.9% reported an annual household income of less than $20,000, whereas 22.3% earned $75,000 or more.

The relationship between income and physical (in)activity, using OLS regression, is described in Table 2. This relationship is first examined for the entire sample, and then stratified by gender, and college education. Study findings revealed that in comparison to the reference group (<$20,000 annual income), individuals with an income of ≥$75,000 engaged in 4.6 more daily minutes of MVPA, in the fully adjusted model. These findings were similar among men and women, but more pronounced for those with a college education versus those without a college degree. That is, college educated individuals in the highest income stratum engaged in 8.1 more daily minutes of MVPA in comparison to the reference group; whereas those with the highest income who were not college educated engaged in only 3.9 more minutes of MVPA daily. Similar findings, but in the opposite direction, were observed between income and light intensity activity in the fully adjusted models. Specifically, those in the highest income stratum engaged in 9.3 fewer minutes of light intensity activity than the reference group. Regarding income and sedentary behavior, those in the high-income strata spent 11.8 more minutes daily sedentary than their lower income counterparts (p-value < 0.01).

Table 3 describes the relationship between income and bouts of MVPA. Analysis revealed that individuals in the highest income strata engaged in significantly more bouted MVPA in comparison to the reference group (b = 2.55; SE = 0.77). However, when the log transformed variable served as the dependent variable the relationship did not quite reach statistical significance (p-value = 0.057). In the two-part model (Table 4a) and marginal effects (Table 4b), income was significantly related to bouts of MVPA. Specifically, those in the highest income category engaged in 2.4 more bouted daily minutes of MVPA than the reference group.

Table 5 presents the relationship between income and meeting physical activity guidelines during the week and a brief (2-day) time period. The fully adjusted logistic regression model revealed that in comparison to the reference group, individuals in the high-income stratum were 1.6 times more likely to meet guidelines for the 2-day period (Odds Ratio = 1.58, 95%CI 1.03, 2.42). Individuals in the high-income group were 1.9 times more likely to meet guidelines during a 7-day period, with statistical significance (Odds Ratio = 1.92, 95%CI 1.08, 3.39).

Table 1
Descriptive characteristics of sample: NHANES 2003–2006[a] (n = 5206).

Characteristics	% (n)	Weighted %
Gender		
Women	47.93% (2495)	50.40%
Age: mean (SE)	51.72 (18.58)	48.41
Age groups (years)		
18–39.9	29.04% (1512)	32.81%
40–59.9	32.27% (1680)	42.14%
≥60	38.69% (2014)	25.04%
Household size (SE)	2.91 (1.57)	2.86
Race/ethnicity		
Non-Hispanic White	54.01% (2812)	10.65%
Non-Hispanic Black	19.09% (994)	75.33%
Hispanic	23.38% (1217)	9.29%
Other	3.52% (183)	4.74%
Marital status		
Married	57.74% (3006)	61.33%
Widow	9.83% (512)	6.26%
Divorced/separated	12.45% (648)	12.06%
Never married	14.48% (754)	14.58%
Education		
<High school	28.06% (1461)	15.48%
High school	25.80% (1239)	24.99%
Some college	27.62% (1438)	31.60%
≥College	20.51% (1068)	26.39%
Annual household income-categories		
<$20,000	21.88% (1139)	14.19%
$20,000–$44,999	33.40% (1739)	29.22%
$45,000–$74,999	26.39% (1163)	26.27%
≥$75,000	22.34% (1165)	30.32%
BMI (kg/m^2) - mean (SE)	28.46 (6.16)	28.37
BMI (kg/m^2) categories		
Underweight (<18.5)	1.36% (71)	1.53%
Normal weight (18.5–24.9)	29.14% (1517)	31.12%
Overweight (25.0–29.9)	35.96% (1872)	34.57%
Obese (≥30.0)	33.54% (1746)	32.78%
Self-reported health status		
Excellent	10.33% (538)	12.33%
Very good	29.89% (1556)	35.64%
Good	38.40% (1999)	36.92%
Fair	18.25% (950)	12.86%
Poor	3.13% (163)	2.25%
Sedentary time, minutes per day[b] - mean (SE)	490.87 (123.82)	487.10
Light physical activity, minutes per day[b] - mean (SE)	258.63 (69.53)	259.28
MVPA, minutes per day[b] - mean (SE)	21.91 (23.91)	23.96
MVPA, bouted minutes per day[b] - mean (SE)	6.32 (13.04)	6.78
Total accelerometer wear time - hours per day[b] - mean (SE)	14.25 (2.46)	14.32
Meeting MVPA Guidelines[b]	7.55% (393)	8.02%

SE - Standard Error; MVPA - moderate to vigorous intensity physical activity.
[a] Analytic sample from the National Health and Nutrition Examination Survey 2003–2006.
[b] Information on sedentary time and physical activity were derived from accelerometers. Continuous sedentary time and physical activity are in minutes per day. The intensity levels are based on Freedson's cut-points; i.e., sedentary time (0–99 counts per minutes (cmp)), light intensity physical activity (100–1951 cpm), and moderate to vigorous intensity physical activity (≥1952 cpm). Accelerometer wear time- mean wear time in hours per day from all valid days. Meeting physical activity guidelines refers to engaging in 150 min or more per week of moderate and vigorous intensity physical activity.

4. Discussion

Using accelerometers to objectively measure physical activity among a national sample of U.S. adults, we conclude that individuals within the highest income stratum utilized the scarce resource of time more 'wisely' by engaging in activity more intensely. In particular,

Table 2
Association between income, physical activity levels and sedentary behavior: OLS regression[a].

	MVPA[b]			Light intensity PA[b]			Sedentary behavior[b]		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI
Total[c] Annual household income-categories (<$20,000 reference)									
$20,000–44,999	2.37	2. 24	0.99	4.94	3.40	−3.59	−9.74	−13.42	−9.32
	(0.99)	(1.00)	(0.86)	(3.27)	(3.00)	(1.70)	(6.46)	(5.27)	(4.63)
	0.35, 4.38	0.20, 4.27	−0.77, 2.73	−1.74, 11.61	−2.74, 9.53	−7.07, −0.12	−22.93, 3.46	−24.17, −2.67	−18.27,0.28
$45,000–74,999	2.48	2.31	1.03	4.65	2.62	−4.30	−8.63	−13.48	−8.70
	(1.05)	(1.06)	(0.94)	(3.33)	(3.16)	(2.25)	(5.99)	(4.59)	(4.08)
	0.35, 4.62	0.15, 4.48	−0.90, 2.97	−2.16, 11.45	−3.85, 9.08	−8.89, 0.29	−20.86, 3.60	−22.85, −4.12	−17.18, −0.63
≥$75,000	4.86	4.53	4.61	−7.78	−11.69	−9.31	12.12	2.79	11.79
	(0.97)	(0.99)	(1.02)	(3.99)	(3.87)	(2.57)	(6.47)	(5.13)	(5.02)
	2.89, 6.83	2.50, 6.56	2.53, 6.69	−15.92, 0.36	−19.60, −3.79	−14.56, −4.06	−1.10, 25.34	−7.68, 13.27	1.54, 21.99
Women[c]									
$20,000–44,000	1.63	1.34	1.01	4.82	−0.24	−3.09	6.28	−4.91	−2.08
	(0.78)	(0.82)	(0.70)	(4.80)	(3.88)	(1.78)	(7.26)	(6.69)	(5.95)
	0.04, 3.22	−0.33, 3.01	−0.41, 2.44	−4.97, 14.62	−8.16, 7.69	−6.71, 0.54	−8.55, 21.11	−18.56, 8.75	−14.23, 10.08
$45,000–75,000	2.15	1.80	1.71	1.69	−4.38	−5.13	12.12	−1.30	2.50
	(0.86)	(0.93)	(0.92)	(4.61)	(4.12)	(2.39)	(7.87)	(5.72)	(5.59)
	0.39, 3.91	−0.09, 3.69	−0.16, 3.58	−7.72, 11.11	−12.79, 4.04	−10.02, −0.24	−3.95, 28.18	−12.97, 10.38	−8.91, 13.92
≥$75,000	4.86	4.39	4.62	−3.86	−11.93	−9.99	21.17	3.33	12.61
	(0.98)	(1.03)	(1.05)	(6.05)	(5.97)	(3.28)	(9.33)	(7.74)	(7.48)
	2.86, 6.86	2.30, 6.49	2.47, 6.76	−16.21, 8.50	−24.11, 0.26	−16.68, −3.30	2.11, 40.23	−12.47, 19.13	−2.66–27.88
Men[c]									
$20,000–45,000	3.62	3.83	1.19	4.38	6.51	−4.79	−29.09	−23.60	−16.44
	(1.76)	(1.77)	(1.44)	(3.81)	(4.21)	(2.25)	(11.09)	(7.89)	(6.57)
	0.03, 7.21	0.23, 7.44	−1.74, 4.12	−3.40, 12.16	−2.09, 15.10	−9.39, −0.19	−51.74, −6.44	−39.71, −7.48	−29.86, −3.01
$45,000–75,000	3.07	3.28	0.42	6.15	8.15	−4.06	−30.68	−25.51	−19.39
	(1.88)	(1.87)	(1.51)	(4.11)	(4.32)	(2.88)	(9.10)	(7.52)	(6.20)
	−0.77, 6.92	−0.54, 7.09	−2.66, 3.50	−2.24, 14.54	−0.67, 16.97	−9.94, 1.81	−49.26, −12.10	−40.87, −10.15	−32.06, −6.74
≥$75,000	5.23	5.24	5.42	−12.72	−12.63	−11.87	1.37	1.59	11.37
	(1.68)	(1.69)	(1.44)	(4.45)	(4.38)	(2.88)	(9.33)	(7.58)	(6.46)
	1.79–8.67	1.79, 8.69	2.47, 8.36	−21.80, −3.64	−21.58, −3.68	−17.76, −5.99	−17.69, 20.43	−13.89, 17.07	−1.81, −24.55
<College educated[c]									
$20,000–45,000	1.77	1.66	0.41	4.50	3.28	−3.45	−10.13	−13.06	−9.46
	(0.98)	(0.99)	(0.79)	(3.25)	(2.81)	(1.73)	(6.46)	(5.29)	(4.39)
	−0.24, 3.78	−0.36, 3.68	−1.22, 2.03	−2.14, 11.14	−2.45, 9.01	−7.00, 0.09	−23.32, 3.06	−23.87, −2.25	−18.43, −0.49
$45,000–75,000	2.10	1.93	1.00	2.65	0.84	−4.19	−5.40	−9.75	−5.56
	(1.21)	(1.20)	(1.04)	(3.52)	(3.14)	(2.52)	(5.90)	(5.07)	(4.37)
	−0.38–4.57	−0.53, 4.40	−1.14, 3.13	−4.54, 9.84	−5.57, 7.25	−9.33, 0.96	−17.44, 6.64	−20.10, 0.61	−14.48, 3.36
≥$75,000	3.53	3.08	3.93	−8.95	−13.98	−9.44	20.88	8.79	15.46
	(1.12)	(1.15)	(1.16)	(4.38)	(4.28)	(3.17)	(6.40)	(4.87)	(4.98)
	1.25, 5.81	0.74, 5.42	1.55, 6.30	−17.90, 0.01	−22.71, 5.25	−15.92, −2.97	7.81, 33.96	−1.15–18.74	5.30, 25.63
≥College educated[c]									
$20,000–45,000	4.29	3.90	4.55	−1.69	−8.81	−4.53	24.56	7.73	13.45
	(3.64)	(3.70)	(3.51)	(9.95)	(9.48)	(5.29)	(16.31)	(13.03)	(12.30)
	−3.15, 11.73	−3.65, 11.45	−2.62, 11.71	−22.01, 18.64	−28.16, 10.55	−15.34, 6.29	−8.74, 57.87	−18.88, 34.34	−11.73, 38.62
$45,000–75,000	3.12	2.74	2.53	2.16	−4.60	−5.99	13.48	−2.51	1.51
	(3.37)	(3.46)	(3.43)	(10.61)	(9.71)	(4.72)	(17.50)	(14.07)	(14.00)
	−3.76, 9.99	−4.32, 9.81	−4.48, 9.54	−19.50, 23.82	−24.42, 15.22	−15.63, 3.64	−22.26, 49.23	−31.24, 26.22	−27.08, 30.10
≥$75,000	7.21	6.87	8.07	−14.56	−20.79	−12.83	29.11	14.38	24.44
	(3.40)	(3.49)	(3.48)	(10.29)	(9.32)	(4.74)	(15.43)	(12.93)	(13.10)
	0.26, 14.16	−0.26, 14.00	0.97, 15.18	−35.57, 6.46	−39.83, −1.75	−22.50, −3.16	−2.41, 60.63	−12.02, 40.78	−2.32, 51.21

CI - Confidence Intervals; SE - Standard Error; PA - physical activity; MVPA - moderate to vigorous intensity physical activity, OLS - Ordinary Least Square Regression; b - co-efficient. The co-efficient refers to changes in daily minutes of sedentary, light, or MVPA in comparison to the reference category.

[a] Multivariate OLS regression models were constructed for sedentary behavior, light intensity physical activity, and moderate-to-vigorous intensity physical activity. Model 1 adjusts for age, race/ethnicity, gender, household size, marital status, education, health status, BMI. Models 2 controls for all the variables in model 1 + accelerometer wear time. Models 3 controls for variables in model 2 + total physical activity when light and MVPA are the dependent variable. When sedentary behavior is the dependent variable, model 3 adjusts for all variables in model 2 + MVPA. NHANES weights were utilized.

[b] Information on sedentary time and physical activity were derived from accelerometers. Continuous sedentary time and physical activity are in minutes per day. The intensity levels are based on Freedson's cut-points; i.e., sedentary time (0–99 counts per minutes (cmp)), light intensity physical activity (100–1951 cpm), and moderate to vigorous intensity physical activity (≥1952 cpm).

[c] The number of observations for the total sample: $n = 5206$; for women: $n = 2711$; for men: 2495; for <college educated: $n = 4138$; for ≥college educated: $n = 1068$.

individuals with an annual household income of 75,000 dollars or higher were significantly more likely to engage in objectively determined MVPA, while adjusting for total volume of activity. This finding, using objective assessment of activity, is consistent with the results of Meltzer and Jena (Meltzer and Jena, 2010) using self-reported physical activity data.

The same energy expenditure may be reached through vigorous intensity physical activity for a shorter duration as moderate activity for a

Table 3
Association between income and bouts[a] of moderate to vigorous intensity physical activity OLS regression[b].

	Bouts[a] of moderate-to-vigorous intensity physical activity (MVPA)					
	MVPA			MVPA log (minutes)[c]		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI
Annual household income-categories (<$20,000 reference)						
$20,000–44,999	0.82	0.80	0.54	0.06	0.09	0.07
	(0.61)	(0.61)	(0.60)	−0.06	(0.07)	(0.07)
	−0.43, 2.06	−0.45, 2.04	−0.68, 1.76	−0.06, 0.23	−0.06, 0.24	−0.07, 0.22
$45,000–74,999	0.48	0.46	0.20	0.084	0.054	0.043
	(0.62)	(0.63)	(0.62)	−0.08	(0.07)	(0.07)
	−0.78, 1.75	−0.82, 1.74	−1.06, 1.46	−0.09, 0.20	−0.09, 0.20	−0.10, 0.19
≥$75,000	2.54	2.49	2.55	0.31	0.19	0.19
	(0.75)	(0.76)	(0.77)	−0.07	(0.10)	(0.10)
	1.00, 4.08	0.94, 4.05	0.98, 4.11	−0.01, 0.38	−0.01, 0.38	−0.01, 0.39

NHANES - National Health and Nutrition Examination Survey; SE - Standard Error; MVPA - moderate to vigorous intensity physical activity; OLS - Ordinary Least Square Regression; Log - Logarithmic transformation; b - co-efficient. The co-efficient refers to changes in daily minutes of bouts of MVPA in comparison to the reference category.

[a] Bouts of moderate to vigorous intensity physical activity refers to the accumulation of minutes per day spent in bouts lasting 10 min or more. This is an indication of structured physical activity or exercise.

[b] Multivariate OLS regression models were constructed for sedentary behavior, light intensity physical activity, and moderate-to-vigorous intensity physical activity. Model 1 adjusts for age, race/ethnicity, gender, household size, marital status, education, health status, BMI. Models 2 controls for all the variables in model 1 + accelerometer wear time. Models 3 controls for variables in model 2 + total physical activity. NHANES weights were utilized.

[c] Sample size was reduced to $n = 2330$ in the log transformed models because log (0) is undefined, therefore these observations were dropped.

longer duration; thus, one may achieve the same health benefits by choosing either option. Meeting physical activity guidelines can be translated into reaching (or exceeding) 500 Metabolic Equivalent of Task (MET) minutes per week. Please note that 1 MET is equivalent to a resting metabolic rate (or simply sitting quietly), 3–6 METs is considered moderate intensity activity, and >6 METs is regarded as vigorous intensity activity. Thus, one can meet recommended guidelines by engaging in moderate intensity activity, such as walking at very brisk pace of 4 mph (5 METs) for 100 min per week ($5 * 100 = 500$ MET minutes per week) or going on a fast bicycle ride of 14–15.9 mph (10.0 METs) for half the time, that is, 50 min weekly ($10 * 50 = 500$ MET minutes per week), and still meet guidelines (Ainsworth et al., 2011).

Thus, current study findings indicate that those with higher incomes might be cognizant of this fact and allocate their time more effectively to improve their over-all health and well-being. However, this cannot be substantiated without measuring the cognitive processes associated with decisions to be physically active, or not. Unfortunately, these data are not available in NHANES. Nonetheless, we expand on the literature by exploring whether this tendency for allocating time more effectively 'spills over' to the frequency of physical activity during the week. That is, whether wealthier individuals tend to be 'weekend warriors', i.e., fitting in their required exercise in fewer days. Indeed, findings revealed that high income individuals met suggested physical activity guidelines over a 2-day period more than their lower income counterparts. Present analyses also found that income was inversely related to light intensity physical activity, and positively related to sedentary behavior. There is growing evidence to support that these two behaviors are independently related to health outcomes, irrespective of the protective effects of

Table 4a
Association between income and bouts[a] of moderate to vigorous intensity physical activity (MVPA): Two Part Model[b].

	MVPA					
	Model 1[c]		Model 2[c]		Model 3[c]	
	Probit	Regress	Probit	Regress	Probit	Regress
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
	95%CI	95%CI	95%CI	95%CI	95%CI	95%CI
Annual household income-categories (<$20,000 reference)						
$20,000–44,999	0.05	1.47	0.04	1.48	0.00	1.11
	(0.07)	(1.09)	(0.07)	(1.09)	(0.07)	(1.08)
	−0.08, 0.18	−0.67, 3.61	−0.09, 0.17	−0.66, 3.62	−0.13, 0.14	−1.01, 3.23
$45,000–74,999	0.10	0.44	0.09	0.45	0.06	0.17
	(0.072)	(1.11)	(0.07)	(1.11)	(0.08)	(1.10)
	−0.04, 0.24	−1.73, 2.60	−0.05, 0.24	−1.72, 2.61	−0.09, 0.21	−1.99, 2.34
≥$75,000	0.29	2.39	0.27	2.41	0.29	2.58
	(0.08)	(1.25)	(0.08)	(1.24)	(0.08)	(1.25)
	0.13, 0.44	−0.05, 4.84	0.12, 0.43	−0.03, 4.85	0.13, 0.45	0.14, 5.03

MVPA - moderate to vigorous intensity physical activity; SE - Standard Error; b - co-efficient; CI - Confidence Interval.

[a] Bouts of moderate to vigorous intensity physical activity refers to the accumulation of minutes per day spent in bouts lasting 10 min or more. This is an indication of structured physical activity or exercise.

[b] The first part of two-part model depicts the probability of having non-zero bouted minutes, and the second step runs the least squares regression on covariates while integrating the systematic error term. The marginal effects are the predicted effects of income on bouted minutes.

[c] Model 1 adjusts for age, race/ethnicity, gender, household size, marital status, education, health status, BMI. Models 2 controls for all the variables in model 1 + accelerometer wear time. Models 3 controls for variables in model 2 + total physical activity. NHANES weights were utilized.

Table 4b
Association between income and bouts[a] of moderate to vigorous intensity physical activity (MVPA): Marginal effects[b] of the Two Part Model[b].

	Margins of bouts of MVPA[c]		
	Model 1[c]	Model 2[c]	Model 3[c]
	b (SE) 95%CI	b (SE) 95%CI	b (SE) 95%CI
Annual household income-categories (<$20,000 reference)			
$20,000–44,999	0.90 (0.59) −0.25, 2.05	0.88 (0.59) −0.27, 2.03	0.52 (0.57) −0.60, 1.50
$45,000–74,999	0.66 (0.61) −0.53, 1.86	0.64 (0.61) −0.55, 1.83	0.34 (0.59) −0.83, 1.50
≥$75,000	2.43 (0.68) 1.09, 3.77	2.37 (0.68) 1.04, 3.71	2.42 (0.67) 1.12, 3.72

NHANES - National Health and Nutrition Examination Survey; SE - Standard Error; MVPA - moderate to vigorous intensity physical activity CI - Confidence Interval; b - co-efficient.
[a] Bouts of moderate to vigorous intensity physical activity refers to the accumulation of minutes per day spent in bouts lasting 10 min or more. This is an indication of structured physical activity or exercise.
[b] The first part of two-part model depicts the probability of having non-zero bouted minutes, and the second step runs the least squares regression on covariates while integrating the systematic error term. The marginal effects are the predicted effects of income on bouted minutes.
[c] Model 1 adjusts for age, race/ethnicity, gender, household size, marital status, education, health status, BMI. Models 2 controls for all the variables in model 1 + accelerometer wear time. Models 3 controls for variables in model 2 + total physical activity. NHANES weights were utilized.

MVPA (Herzig et al., 2014; Matthews et al., 2012). Thus, in this respect, higher income individuals are not using their time 'wisely' with regards to light intensity activity and sedentary time.

Study results have implications that are pertinent to clinicians and public health professionals. Most notably, it is important to consider the scare resource of time when encouraging physical activity to high and low income individual alike. Specifically, high income individuals tend to engage in high intensity activity for a shorter duration than their lower income counterparts, which might be due to increased awareness of the advantage of this approach or to the value of their time. Lower income individuals, in comparison, might be less aware of this approach, even though they could potentially benefit from encouragement to use their time "wisely" with regards to exercise intensity/duration as a means to overcome the impediment of lack of time. However, the applicability of this strategy to low-income individuals has yet to be examined, and the unique impediments to physical activity that this subpopulation faces on the individual (e.g., lack of self-efficacy), social (e.g., lack of social support), and societal level (e.g., crime in neighborhoods) need to be addressed. Thus, it is important to change the status quo to one that promotes an active lifestyle (e.g. active transport), through modifying social norms and the physical environment (Shuval et al., 2017). In addition, financial incentives (e.g., for gym use) have shown promise to increase physical activity levels and could be applied to both low and high income households alike (Charness and Gneezy, 2009; Leonard and Shuval, 2017).

It should be noted that engaging in high intensity exercise from the start of a program may result in a higher risk of injury, particularly for those who were previously inactive (Physical Activity Guidelines Advisory Committee, 2008). Therefore, specific instructions should be provided pertaining to increasing the duration and intensity of activity gradually to avoid sustaining injury, or alternatively to engage in moderate intensity activity (e.g., brisk walking) for at least 150 min a week, which markedly reduces the risk for injury. In addition, the importance of increasing light intensity activity and decreasing sedentary time throughout the day should be conveyed particularly to high income individuals who are prone to excessive sitting, and environmental changes should be implemented, such as introducing stand-up desks at the workplace, to facilitate behavior change (Wendel et al., 2016).

While the element of time is a well-recognized impediment to physical activity (Siddiqi et al., 2011), its implications regarding individuals with various levels of income has rarely been considered when designing interventions. Most of the research focusing on promoting physical activity among low-income populations has focused on programs for ethnic minority underserved populations, that experience higher prevalence rates of obesity, type 2 diabetes, and lower levels of self-reported physical activity (Siddiqi et al., 2011). For example, interventions have been culturally tailored and faith-based (Faridi et al., 2010; Marcus et al., 2006); yet the elements of time and the intensity of exercise have rarely been considered. Study findings pertaining to income and the 'weekend warrior' effect, underscore the importance of tailoring the message to meet physical activity guidelines both to low and high income individuals. Since adhering to guidelines (e.g. 150 min of weekly moderate intensity activity) can be achieved over a 3-day period, for example, versus a 7-day period, this message should be conveyed and might facilitate the adoption of physical activity, particularly for those pressed for time.

Study findings should be interpreted in the context of its limitations. Although the study sample is a large nationally representative sample consisting of 2 waves, the data are cross-sectional. Therefore, a temporal and causal relationship between income and physical activity patterns cannot be established without using longitudinal data. Additionally,

Table 5
Association between income and meeting physical activity (PA) guidelines for a 2-day 'warrior'[a] and for 7-days: logistic regression[a].

Meeting PA guidelines	2-Day 'warrior'			7-Days		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Annual household income-categories (<$20,000 reference)						
$20,000–44,999	1.41 (0.90, 2.21)	1.42 (0.90, 2.23)	1.27 (0.80, 2.01)	1.21 (0.74, 1.99)	1.21 (0.73, 2.00)	1.17 (0.71, 1.92)
$45,000–74,999	1.04 (0.66, 1.63)	1.04 (0.66, 1.64)	0.88 (0.53, 1.44)	1.22 (0.68, 2.19)	1.22 (0.67, 2.19)	1.15 (0.63, 2.09)
≥$75,000	1.47 (0.97, 2.23)	1.47 (0.96, 2.26)	1.58 (1.03, 2.42)	1.87 (1.07, 3.24)	1.87 (1.06, 3.30)	1.92 (1.08, 3.39)

CI - Confidence Interval; OR - Odds Ratio; Number of observations: $n = 5206$.
[a] Logistic regression models were estimated for meeting physical activity guidelines (150 min of moderate and vigorous activity per week) during a 2 (2-day warrior) and 7-day period. Separate models were constructed where each time-period was considered a separate dependent variable. Model 1 adjusts for age, race/ethnicity, gender, household size, marital status, education, health status, BMI. Models 2 controls for all the variables in model 1 + accelerometer wear time. Models 3 controls for variables in model 2 + total physical activity. NHANES weights were utilized.

although physical activity and sedentary time were measured objectively, annual household income was based on self-report which may be subject to recall bias. Moreover, despite the objective nature of the physical activity assessment, wearing an accelerometer might impact the behavior of those wearing the device, a phenomenon known as the Hawthorne Effect (McCarney et al., 2007).

In conclusion, this study contributes to the literature by finding a significant relationship between income and the use of time to efficiently engage in objectively measured physical activity. The fact that individuals from high income strata, but not those with lower income, use their time more 'wisely' to engage in more vigorous intensity activity, but not light intensity activity and sedentary behavior, should be considered when designing interventions. Our findings also reveal that higher income individuals are more efficient with regards to the frequency of physical activity, that is, they meet the suggested guidelines in fewer days than their lower income counterparts. Targeted messages (e.g., via social marketing or health education) emphasizing that physical activity goals can be reached through more vigorous, but less frequent activity, could be directed at both low and high income individuals in future intervention studies. However, the effects of such an approach warrant investigation in randomized controlled trials to determine its efficacy and subsequent effectiveness. This can be attempted alongside facilitating change to the social and physical environment that encourage active living.

Conflicts of interest & funding

None.

References

Ainsworth, B.E., Haskell, W.L., Herrmann, S.D., Meckes, N., Bassett, D.R., Tudor-Locke, C., Greer, J.L., Vezina, J., Whitt-Glover, M.C., Leon, A.S., 2011. 2011 compendium of physical activities: a second update of codes and MET values. Med. Sci. Sports Exerc. 43, 1575–1581.

Becker, G.S., 1975. Human Capital: A Theoretical and Empirical Analysis, With Special Reference to Education. 2nd ed. National Bureau of Economic Research.

Cawley, J., 2004. An economic framework for understanding physical activity and eating behaviors. Am. J. Prev. Med. 27, 117–125.

Centers for Disease Control and Prevention, National Health and Nutrition Examination Survey [WWWDocument] http://www.cdc.gov/nchs/nhanes.htm (accessed 5.1.15a). (n.d.-a).

Centers for Disease Control and Prevention, 2006b. NHANES 2003 –2004 Physical Activity Monitor Data Documentation, Codebook, and Frequencies [WWW Document]. (accessed 1.14.08b)http://www.cdc.gov/nchs/nhanes/nhanes2003-2004/PAXRAW_C.htm (accessed 1.14.08b).

Cerin, E., Cain, K., Oyeyemi, A., Owen, N., Conway, T.T.C., VAN Dyck, D., Schipperijn, J., Mitáš, J., Toftager, M., Aguinaga-Ontoso, I., Sallis, J., 2016. Correlates of agreement between accelerometry and self-reported physical activity. Med. Sci. Sports Exerc. 48, 1075–1084.

Charness, G., Gneezy, U., 2009. Incentives to exercise. Econometrica 77:909–931. http://dx.doi.org/10.3982/ECTA7416.

Ding, D., Lawson, K.D., Kolbe-alexander, T.L., Finkelstein, E.A., Katzmarzyk, P.T., Mechelen, W. Van, Pratt, M., 2016. The economic burden of physical inactivity: a global analysis of major non-communicable diseases. Lancet 6736, 1–14.

Faridi, Z., Shuval, K., Njike, V.Y., Katz, J.A., Jennings, G., Williams, M., Katz, D.L., 2010. Partners reducing effects of diabetes (PREDICT): a diabetes prevention physical activity and dietary intervention through African-American churches. Health Educ. Res. 25, 306–315.

Freedson, P.S., Melanson, E., Sirard, J., 1998. Calibration of the Computer Science and Applications, Inc. accelerometer. Med. Sci. Sports Exerc. 30, 777–781.

Fuchs, V.R., 1982. Economic Aspects of Health. National Bureau of Economic Research Conference Report.

Grossman, M., 1999. The Human Capital Model of the Demand for Health. NBER Working Paper No. 7078.

Haskell, W.L., Lee, I.-M., Pate, R.R., Powell, K.E., Blair, S.N., Franklin, B.A., Macera, C.A., Heath, G.W., Thompson, P.D., Bauman, A., 2007. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Med. Sci. Sports Exerc. 39:1423–1434. http://dx.doi.org/10.1249/mss.0b013e3180616b27.

Healy, G., Dunstan, D., Salmon, J., Cerin, E., Shaw, J., Zimmet, P., Owen, N., 2007. Objectively measured light-intensity physical activity is independently associated with 2-h plasma glucose. Diabetes Care 30, 1384–1389.

Herzig, K.-H., Ahola, R., Leppäluoto, J., Jokelainen, J., Jämsä, T., Keinänen-Kiukaanniemi, S., 2014. Light physical activity determined by a motion sensor decreases insulin resistance, improves lipid homeostasis and reduces visceral fat in high-risk subjects: PreDiabEx study RCT. Int. J. Obes. 38, 1089–1096.

Kohl, H.W., Craig, C.L., Lambert, E.V., Inoue, S., Alkandari, J.R., Leetongin, G., Kahlmeier, S., 2012. The pandemic of physical inactivity: global action for public health. Lancet 380, 294–305.

Kushi, L.H., Doyle, C., McCullough, M., Rock, C.L., Demark-Wahnefried, W., Bandera, E.V., Gapstur, S., Patel, A.Vp., Kimberly, A., Gansler, T., 2012. American Cancer Society guidelines on nutrition and physical activity for cancer prevention reducing the risk of cancer with healthy food choices and physical activity. CA Cancer J. Clin. 62, 30–67.

Lee, I.-M., Sesso, H.D., Oguma, Y., Paffenbarger, R.S., 2004. The "weekend warrior" and risk of mortality. Am. J. Epidemiol. 160:636–641. http://dx.doi.org/10.1093/aje/kwh274.

Leonard, T., Shuval, K., 2017. Behavioral economic tools for promotion of physical activity. Behavioral Economics and Healthy Behaviors: Key Concepts and Current Research. Routledge, London and New York.

Madden, D., 2008. Sample selection versus two-part models revisited: the case of female smoking and drinking. J. Health Econ. 27:300–307. http://dx.doi.org/10.1016/j.jhealeco.2007.07.001.

Marcus, B.H., Williams, D.M., Dubbert, P.M., Sallis, J.F., King, A.C., Yancey, A.K., Franklin, B.A., Buchner, D., Daniels, S.R., Claytor, R.P., 2006. Physical activity intervention studies. Circulation 114:2739. http://dx.doi.org/10.1161/CIRCULATIONAHA.106.179683.

Matthews, C.E., Chen, K.Y., Freedson, P.S., Buchowski, M.S., Beech, B.M., Pate, R.R., Troiano, R.P., 2008. Amount of time spent in sedentary behaviors in the United States, 2003–2004. Am. J. Epidemiol. 167, 875–881.

Matthews, C.E., George, S.M., Moore, S.C., Bowles, H.R., Blair, A., Park, Y., Troiano, R.P., Hollenbeck, A., Schatzkin, A., 2012. Amount of time spent in sedentary behaviors and cause-specific mortality in US adults. Am. J. Clin. Nutr. 95, 437–445.

McCarney, R., Warner, J., Iliffe, S., van Haselen, R., Griffin, M., Fisher, P., 2007. The Hawthorne Effect: A Randomised, Controlled Trial. 2007 7 p. 30.

Meltzer, D.O., Jena, A.B., 2010. The economics of intense exercise. J. Health Econ. 29: 347–352. http://dx.doi.org/10.1016/j.jhealeco.2010.03.005.

Mullahy, J., 1998. Much ado about two: reconsidering retransformation and the two-part model in health econometrics. J. Health Econ. 17:247–281. http://dx.doi.org/10.1016/S0167-6296(98)00030-7.

National Cancer Institute, 2017. SAS Programs for Analyzing NHANES 2003–2004 Accelerometer Data [WWW Document]. http://appliedresearch.cancer.gov/nhanes_pam/ (10 March 2014) (accessed 3.10.14).

Nguyen, B.T., Ford, C.N., Yaroch, A.L., Shuval, K., Drope, J., 2017. Food security and weight status in children: interactions with food assistance programs. Am. J. Prev. Med. 52: S138–S144. http://dx.doi.org/10.1016/j.amepre.2016.09.009.

Owen, N., Healy, G.N., Matthews, C.E., Dunstan, D.W., 2010. Too much sitting: the population-health science of sedentary behavior. Exerc. Sport Sci. Rev. 38:105–113. http://dx.doi.org/10.1097/JES.0b013e3181e373a2.

Parks, S.E., Housemann, R.A., Brownson, R.C., 2003. Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. J. Epidemiol. Community Health 57, 29–35.

Physical Activity Guidelines Advisory Committee, 2008. Physical Activity Guidelines Advisory Committee Report, 2008 (Washington, DC).

Prince, S.A., Adamo, K.B., Hamel, M.E., Hardt, J., Gorber, S.C., Tremblay, M., 2008. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. Int. J. Behav. Nutr. Phys. Act. 5, 56.

Sallis, J.F., Cervero, R.B., Ascher, W., Henderson, K.A., Kraft, M.K., Kerr, J., 2006. An ecological approach to creating active living communities. Annu. Rev. Public Health 27, 297–322.

Shuval, K., Hébert, E.T., Siddiqi, Z., Leonard, T., Lee, S.C., Tiro, J. a, McCallister, K., Skinner, C.S., 2013. Impediments and facilitators to physical activity and perceptions of sedentary behavior among urban community residents: the Fair Park Study. Prev. Chronic Dis. 10, E177.

Shuval, K., Nguyen, B.T., Yaroch, A.L., Drope, J., Gabriel, K.P., 2015. Accelerometer determined sedentary behavior and dietary quality among US adults. Prev. Med. 78, 38–43.

Shuval, K., Leonard, T., Drope, J., Katz, D.L., Patel, A.V., Maitin-Shepard, M., Amir, O., Grinstein, A., 2017. Physical activity counseling in primary care: insights from public health and behavioral economics. CA Cancer J. Clin. 67, 233–244.

Siddiqi, Z., Tiro, J. a, Shuval, K., 2011. Understanding impediments and enablers to physical activity among African American adults: a systematic review of qualitative studies. Health Educ. Res. 26, 1010–1024.

Troiano, R.P., Berrigan, D., Dodd, K.W., Mâsse, L.C., Tilert, T., McDowell, M., 2008. Physical activity in the United States measured by accelerometer. Med. Sci. Sports Exerc. 40: 181–188. http://dx.doi.org/10.1249/mss.0b013e31815a51b3.

U.S. Department of Health and Human Services, 1996. Physical Activity and Health: A Report of the Surgeon General (Atlanta, GA).

Wendel, M.L., Benden, M.E., Zhao, H., Jeffrey, C., 2016. Stand-biased versus seated classrooms and childhood obesity: a randomized experiment in Texas. Am. J. Public Health 106:1849–1854. http://dx.doi.org/10.2105/AJPH.2016.303323.

World Health Organization, 2013. Obesity and Overweight [WWW Document] (Fact Sheet No. 311).