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State-level income inequality and meeting physical activity guidelines; differential associations among US men and women

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ABSTRACT

Background Previous work has identified a relationship between income inequality and risk for obesity and heart attack. We investigated the relationship between state-level income inequality and physical activity among US adults.

Methods We used Behavioral Risk Factor Surveillance System (BRFSS) cross-sectional data from a population based and representative sample of $n = 428\,828$ US adults. Multilevel models were used to determine the association between state-level income inequality and participation in physical activity and strengthening exercises in the previous month.

Results In comparison to males, females were significantly more likely to report being physically inactive (OR = 1.07, 95% CI = 1.04, 1.11), and less likely to meet aerobic activity requirements (OR = 0.90, 95% CI = 0.88, 0.93), meet strengthening activities (OR = 0.71, 95% CI = 0.69, 0.74), and meet overall physical activity recommendations (OR = 0.91, 95% CI = 0.88, 0.94). Cross-level Gini × sex interactions indicated that income inequality was associated with increased odds for participating in no physical activity (OR = 1.08, 95% CI = 1.05, 1.12), decreased odds in participating in strengthening physical activity (OR = 0.92, 95% CI = 0.89, 0.96), aerobic activity (OR = 0.96, 95% CI = 0.93, 0.99), and in meeting overall physical activity recommendations (OR = 0.93, 95% CI = 0.91, 0.95) among women only.

Conclusions Future studies are needed to identify mechanisms in which income inequality leads to physical activity behavior among US women.

Keywords physical activity guidelines, social inequities, state-level socioeconomic characteristics

Introduction

The distribution of incomes in society is a determinant of population health independent of individual income.[1,2] People living in areas with high income inequality—areas in which there is a large gap between the haves and have nots—are at greater risk for mortality,[3] low self-rated health,[3] major depression,[4] coronary heart disease and stroke.[5,6] For example, in a recent population-based cohort study, we identified residing in a state with high income inequality as a risk factor for experiencing a heart attack during follow-up.[5] Of several possible mediators between income inequality and risk for heart attack, we found a significant association between income inequality and risk for class III obesity.[5] Therefore, physical activity and sedentary behavior might explain in part the association between income inequality and coronary heart disease, either because of its possible association with obesity[7] or through other pathways.

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For optimal health during adulthood, the Center for Disease Control recommends 2 h and 30 min of moderate-intensity aerobic activity, such as brisk walking, every week and 2 or more days a week of muscle-strengthening activities that work all major muscle groups.[8] However, in 2008, only one in five adults met overall physical activity guidelines.[9] According to the 2011 Behavioral Risk Factor Surveillance System (BRFSS), 20.6% of US adults, 23.4% of men and 17.9% of women, met both the aerobic and muscle-strengthening guidelines.[10] Significantly higher proportions of younger, and more educated adults met aerobic and strengthening recommendations, in comparison to older and less educated adults, respectively.[10] Among racial groups, the proportion of adults meeting recommendations was lowest among Hispanics than among non-Hispanic blacks, and highest among non-Hispanic whites.[10] The proportion of adults meeting recommendations varied across US states, from 12.7% in West Virginia and Tennessee to 27.3% in Colorado.[10] Participation in physical activity was highest in the West and Northeast.[10] Clearly, a majority of US adults are not meeting physical activity recommendations. Therefore, a better understanding of factors that might influence physical activity is warranted.

Although researchers have identified individual level characteristics as predictors of physical activity, socioeconomic features of the environment might also play a role. To our knowledge, only one study has been conducted that investigates the role of income inequality on physical activity behavior. Using data from the 1990 BRFSS, Diez-Roux *et al.*[11] found that state-level income inequality was associated with increased risk for sedentary behavior. Participation in no physical activity was the only measure assessing physical activity behavior available in the 1990 BRFSS.[11] More insight into the relationship between income inequality and physical activity can be obtained by using measures of physical activity consistent with national recommendations.

Income inequality might lead to increased risk for physical inactivity through several mechanisms. First, as indicated, contextual income inequality has shown to be associated with depression,[4,12] particularly among women. One reason for this association is that areas with higher levels of income inequality tend to have a greater number of people in poverty that lack access to resources, such as mental health services.[13,14] Depression is a risk factor for a decreased odds in participation in physical activity[4] and increased risk for sedentary behavior.[11] Also, investment in amenities that promote physical activity, such as parks and recreation centers, and other infrastructure to promote physical activity, such as sidewalks and bike lanes, might be eroded in areas with high income inequality.

The 2011 BRFSS used several physical activity questions to assess physical activity. Therefore, this study will take advantage of these additional measurements in order to gain a better understanding of the relationship between income inequality and physical activity. Thus the objectives of this study are to investigate the association between state-level income inequality and the odds of total physical inactivity, meeting aerobic activity guidelines, muscle strengthening activity guidelines and overall physical activity guidelines.

Methods

Data source

We used data from the BRFSS 2011. The BRFSS is an annually administered national telephone survey collecting information in each US state on health risk behaviors, chronic health conditions, injury and use of preventative services.[15] Data collected in 2011 were chosen because several questions measuring physical activity were administered that are not regularly collected every year. Data collection procedures have been described elsewhere (http://www.cdc.gov/brfss/). Briefly, State health departments, with support from the Centers for Disease Control and Prevention, use random-digit dialing to interview adults aged 18 years and older who are part of the civilian, non-institutionalized population. Ethical approval was obtained from the University of Nevada, Reno Institutional Review Board.

Only respondents residing in the fifty states and the District of Columbia were included, therefore, 77 638 adults living in Guam, the Virgin Islands, and Puerto Rico were excluded yielding a sample size of 428 829. Respondents were excluded if they were missing information on state of residence, sex, race, education, marital status, annual household income and physical activity. Among a total sample of 428 829 adults aged 18 years of age and above, complete data were available for 350 916 (81.8%) respondents. Those missing were more likely to be male, from a household with an income less than $10 000, single, and have less than high school education. Among the participants, 5.5% were missing information on physical activity behavior and 14.9% were missing household income data.

Measures

Area-level covariates

The main exposure was state income inequality, which was measured using the Gini coefficient. The Gini coefficient ranges from 0 (perfect equality, where every household earns exactly the same income) to 1.0 (perfect inequality). The calculation of the Gini coefficient has been described elsewhere.[16] Mathematically the Gini coefficient is defined as one-half of

the average difference in incomes between two individuals randomly sampled from the normalized income.[16]

For this investigation, the Gini coefficient in each of the 50 states and the District of Columbia was obtained from the 2010 US Census.[17] The distribution of the Gini coefficient among the states was standardized using the Z-transformation. The 2010 US Census was used because information collected occurred prior to 2011 when outcome measures were collected. Other state-level covariates included median income, proportion of the state in poverty, proportion of the state population that is African-American, population, size and census regional division [(i) New England (reference category), (ii) Middle Atlantic, (iii) East North Central, (iv) West North Central, (v) South Atlantic, (vi) East North Central, (vii) West South Central, (viii) Mountain and (ix) Pacific]. The metropolitan statistical area (MSA) was used to determine the type of geographical setting in which the respondent lived. The setting was defined as urban (within the central city of the MSA), suburban (within the MSA but not within the central city) and rural (not in the MSA).

To assess mental health, respondents were asked 'Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?' The number of days reported were categorized into none, 1–7 days, 8–14 days, 15–21 days, more than 21 days.

Individual-level covariates

Trained interviewers collected sociodemographic data, which included sex, age, total annual household income, race/ethnicity (white, black, Asian, native, Hispanic and other) and education (incomplete high school, high school, attended college, college graduate).

Outcome measures

Respondents were asked 'During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening or walking for exercise?' Participants who responded 'no' were categorized as being physically inactive.

Participants were then asked 'what type of physical activity or exercise did you spend the most time doing during the past month,' 'How many times per week or per month did you take part in this activity during the past month?' and 'when you took part in this activity, for how many minutes or hours did you usually keep at it?' Respondents were categorized in meeting the recommendations for aerobic activity (yes versus no) if they participated in 2 h and 30 min of moderate-intensity activity per week.

To assess whether respondents met strengthening activities, they were asked: 'During the past month, how many times per week or per month did you do physical activities or exercises to STRENGTHEN your muscles? Do NOT count aerobic activities like walking, running, or bicycling. Count activities using your own body weight like yoga, sit-ups or push-ups and those using weight machines, free weights, or elastic bands.' Participants were categorized yes or no according to whether or not they had met the twice-weekly recommendation for strengthening activities.

The physical activity measures used in the BRFSS have been shown to be sufficiently reliable and valid compared to accelerometer measures to classify populations into activity categories consistent with physical activity recommendations.[18,19]

Statistical analyses

Because individual respondents were nested within US states, we used multilevel logistic modeling to determine the association between state-level socioeconomic characteristics and four outcomes: physical inactivity, participation in aerobic activity, strengthening activity and both aerobic and strengthening activities. Multilevel models are a generalization of the linear model used in traditional regression analysis. Further information regarding the application of this type of analysis in physical activity research is available.[20,21] Ignoring the hierarchical structure of data can lead to inferential errors and that estimating random effect coefficients can more adequately model data structures typically obtained in survey research.[20]

To investigate the potential effect of individual and state-level socioeconomic characteristics on each of the activity outcomes, we adopted a step-up approach and conducted four different sets of analyses.[22] First, we estimated the null model for each outcome so that the overall predicted probability, which indicates the average probability of observing the physical activity outcome across all US states, and the 95% plausible value range could be computed, which is an indication of the degree of variability across states of the likelihood of participating in no physical activity, aerobic activity, strengthening activity and both aerobic and strengthening activity.[22] Next, a set of analyses included the state-level characteristics. We then added all individual-level sociodemographic characteristics. Finally, we tested gender-by-state income inequality interaction terms.

Results

Characteristics of the 2011 BRFSS respondents ($n = 350\,916$) are presented in Table 1. The unweighted n and weighted

percentages are provided. In weighted analysis, slightly over half of the sample was female (52.7%). The weighted percent of whites, blacks, natives, Asians, Hispanics, and other races comprised of 70.7, 10.2, 1.0, 3.9, 12.3 and 1.9% of the sample respectively. A majority of the sample lived in urban settings (65.6%), and was in a couple (65.6%). The average age was 49.9 years (SD = 16.7).

The state-level characteristics in 2010 can also be found in Table 1. The average Gini coefficient across the US states and District of Columbia was 0.45 (SD = 0.02). The state median income was $51 189 (SD = 8524). The overall predicted probability of observing each physical activity outcome across US states and the plausible value range were calculated from the intercept model are found in Table 2. The overall predicted probability ranged from 19.7% for overall physical activity to 32.0% for aerobic activity. The 95% plausible value ranges showed that the estimated prevalence of physical activity outcomes varied significantly across US states. The estimated proportions of respondents participating in no physical activity (19.3–33.8%), met aerobic physical activity recommendations (25.1–39.9%), met strengthening exercise recommendations (21.6–34.9%), and who met both aerobic activity and strengthening recommendations (14.6–26.0%) indicated differences in physical activity behavior across US states.

In the fully adjusted model (Table 3), females in comparison to males, individuals who were older in comparison to younger adults, and blacks, Asians, natives and Hispanics in comparison to white Americans were more likely to be physically inactive. Also, those with higher education (versus those who did not complete high school) and higher household incomes (versus those from households with incomes <$10 000) were significantly less likely to be physically inactive. Conversely, females in comparison to males, blacks, Asians and Hispanics in comparison to whites were less likely to meet aerobic physical activity recommendations, while those from higher household incomes in comparison to those from low household incomes, and those with higher education, in comparison to those who had incomplete high school were significantly more likely to meet aerobic activity recommendations.

In the fully adjusted models (results not shown), a greater standard deviation in Gini coefficient was associated with greater odds for being physically inactive (OR = 1.06, 95% CI = 0.99, 1.12). But was not associated with meeting aerobic, strengthening, or both aerobic and strengthening guidelines.

When a Gini Z-score and sex cross-level interaction term was tested, income inequality was associated with greater odds of physical inactivity (OR = 1.08, 95% CI = 1.05, 1.12) among women but not men (OR = 1.01, 95% CI = 0.95, 1.08),

Table 1 Characteristics of US adults participating in the 2011 Behavioral Risk Factor Surveillance System (BRFSS)

Individual level characteristics	*Unweighted* n	*Weighted Percentage*
Sex		
Male	136 857	47.3
Female	214 059	52.7
Racial background		
White	284 401	70.7
Black	28 050	10.2
Native	4880	1.0
Asian	5769	3.9
Hispanic	19 570	12.3
Other	8246	1.9
Household income, USD		
<10 000	18 567	5.5
10 000–15 000	21 973	5.4
15 000–20 000	27 300	7.6
20 000–25 000	34 374	9.1
25 000–35 000	41 635	11.0
35 000–50 000	52 484	14.0
50 000–75 000	56 050	15.8
>75 000	98 533	31.6
Education		
Less than high school	27 477	13.1
High school	100 826	28.8
Some college	94 008	29.3
College	128 605	28.8
Marital status		
Couple	203 786	65.6
Single	147 130	37.7
Setting		
Urban	183 939	65.6
Suburban	48 461	16.2
Rural	118 516	18.2
	Mean	*Standard deviation*
Age, years	49.9	16.7
State level characteristics (n = 51)	*Mean (SD)*	*Median*
Gini coefficient	0.45 (0.02)	0.45
State median income, USD	51189 (8524)	49 687
Proportion black	12.1 (11.1)	8.7
Proportion poor	14.8 (3.1)	14.6
State population	6 053 834 (6 823 984)	4 339 367

Table 2 The overall predicted probability of observing the physical activity outcome across US states and the plausible value range, which describes the range within each the predicted probability varies across US states

Physical activity outcome	*Overall predicted probability*	*Plausible value range*
No physical activity	25.9%	19.3–33.8%
Aerobic activity	32.0%	25.1–39.9%
Strengthening activity	27.7%	21.6–34.9%
Overall physical activity	19.7%	13.6–26.0%

meaning that greater inequality was associated with greater odds of being physically inactive among women only. When meeting aerobic activity guidelines was the outcome, the cross-level interaction term the Gini and sex cross-level interaction term indicated that an increase in standard deviation of Gini Z-score was associated with a decreased likelihood of meeting aerobic activity among women only (OR = 0.96, 95% CI = 0.93, 0.99). Also, the cross-level sex and Gini Z-score interaction term indicated a decreased likelihood for meeting strengthening activity among women only (OR = 0.92, 95% CI = 0.89, 0.96). Women living in more unequal states experienced a decreased likelihood of meeting these guidelines. There was a main effect of Gini coefficient indicating that there was increased odds for meeting strengthening activity recommendations among men (OR = 1.07, 95% CI = 1.02, 1.12). Similar findings were obtained when the cross-level interaction between Gini Z-score and sex (OR = 0.93, 95% CI = 0.91, 0.95) was tested when meeting both aerobic and overall physical activity recommendations was the outcomes (Table 3).

Discussion

Main findings

This current study is one of the first to investigate the relationship between contextual income inequality and physical activity in a representative sample of the US population. Although there have been empirical studies that investigated the role of income inequality on chronic diseases such as obesity and coronary heart disease,[5,6,23] this is one of the first studies to investigate the association between income inequality and physical activity. Among adult US women, but not men, income inequality was associated with a greater likelihood of being physically inactive and a lower likelihood of meeting aerobic, strengthening and overall physical activity recommendations, while controlling for individual and state level confounders.

Our results also show different associations between income inequality and the type of physical activity. State level Gini coefficient was associated with strength activity but not sedentary, aerobic or total activity. Strength based activity typically requires more equipment or a membership to a facility with such equipment, however, our results show that as inequality increased strength based activity increased.

What is already known on this topic

Our results are consistent with other studies that identify the possible differential association between contextual income inequality and health between men and women.[11] Overall, women's health status might be more susceptible to contextual income inequality. For example, in previous studies, we found an association between state-level income inequality and the incidence of major depression among women[4] and between neighborhood-level income inequality and depressive symptoms among teenage girls in Boston.[24]

What this study adds

This study begins to explore mechanisms that could explain some of the association between income inequality and risk for coronary heart disease among women but not men. Women are less likely to meet physical activity guidelines in highly unequal states. Not meeting physical activity guidelines is associated with an increased risk of CHD for both men and women.[25] Our study does not provide a plausible mechanism for how income inequality is related to CHD among men. Income inequality potentially effects CHD risk among men through other possible pathways such as anxiety or other behavioral mechanisms such as smoking and consuming an unhealthy diet.

Another possible mechanism is that increased income inequality has shown to be associated with increased average working hours. The average worker worked 1868 h in 2007, which was an increase of 181 h from 1979.[26] This increase in working hours has potentially led to an erosion of leisure time. In the US, from 1994 to 2004, there has been a significant decline in time for leisure-time physical activity, from 29.8 to 23.7%.[27] Lack of time is the number one reason people give for not participating in physical activity.[28] Consequently, the amount of leisure time lost might influence women more in comparison to men. Women are more likely to spend more hours with raising children, caring for elderly, and with daily chores. As a result, women are potentially more impacted by increased working hours. Also, household structures have changed greatly over the past decades, particularly in OECD countries.[29] Single-headed households with and without children have risen from an average of 15% in the late 1980s to

Table 3 Cross-sectional adjusted associations between income inequality and odds for participating in no physical activity, meeting aerobic activity, strengthening and overall activity guidelines among participants in the Behavioral Risk Factor Surveillance System (BRFSS)

	No physical activity		*Aerobic activity*		*Strengthening activity*		*Overall physical activity*	
	OR	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*
Intercept	0.31	(0.26,0.36)	0.70	(0.60,0.82)	0.40	(0.34,0.47)	0.20	(0.17,0.24)
State characteristics								
Gini (Z-score)	1.01	(0.95,1.08)	1.01	(0.93,1.09)	1.07	(1.02,1.12)	1.08	(1.02,1.14)
State Median Income (Z-score)	0.95	(0.87,1.05)	1.05	(0.95,1.17)	1.03	(0.97,1.10)	1.02	(0.94,1.12)
Population size (Z-score)	0.95	(0.92,0.99)	1.03	(0.99,1.07)	1.01	(0.99,1.03)	1.01	(0.98,1.05)
Proportion black (Z-score)	1.01	(0.92,1.11)	0.97	(0.87,1.08)	0.98	(0.91,1.06)	0.96	(0.87,1.07)
Proportion in poverty (Z-score)	0.93	(0.82,1.07)	1.06	(0.92,1.22)	0.98	(0.89,1.07)	0.98	(0.87,1.10)
Census division (ref: New England)		1.00		1.00		1.00		1.00
Middle Atlantic	1.15	(1.04,1.27)	0.91	(0.80,1.03)	0.99	(0.91,1.08)	0.97	(0.86,1.10)
East North Central	1.10	(0.96,1.27)	0.94	(0.79,1.12)	1.05	(0.95,1.17)	1.05	(0.91,1.20)
West North Central	1.14	(0.98,1.33)	0.85	(0.74,0.98)	0.95	(0.85,1.06)	0.90	(0.78,1.04)
South Atlantic	1.15	(0.97,1.36)	0.94	(0.76,1.15)	1.04	(0.89,1.22)	1.02	(0.83,1.25)
East Coast Central	1.43	(1.13,1.81)	0.68	(0.50,0.91)	0.85	(0.70,1.04)	0.76	(0.61,0.95)
West South Central	1.30	(1.12,1.51)	0.77	(0.65,0.92)	0.91	(0.79,1.04)	0.86	(0.74,1.00)
Mountain	0.90	(0.72,1.11)	1.10	(0.90,1.34)	1.23	(1.09,1.38)	1.27	(1.09,1.49)
Pacific	0.83	(0.72,0.96)	1.19	(0.97,1.46)	1.11	(0.99,1.24)	1.16	(0.99,1.35)
Individual characteristics								
Sex (ref: male)		1.00		1.00		1.00		1.00
Female	1.06	(1.03,1.09)	0.93	(0.90,0.96)	0.72	(0.70,0.75)	0.81	(0.78,0.84)
Gini Z-score	1.08	(1.05,1.12)	0.96	(0.93,0.99)	0.92	(0.89,0.96)	0.93	(0.91,0.95)
Age (years)	1.01	(1.01,1.02)	1.00	(1.00,1.02)	0.99	(0.98,0.99)	0.99	(0.98,1.00)
Household income, USD (ref: <10 000)		1.00		1.00		1.00		1.00
10 000–15 000	1.02	(0.94,1.10)	0.96	(0.89,1.04)	1.03	(0.94,1.12)	0.97	(0.83,1.13)
15 000–20 000	1.02	(0.96,1.08)	0.96	(0.89,1.03)	1.01	(0.89,1.16)	0.92	(0.79,1.06)
20 000–25 000	0.94	(0.87,1.02)	1.09	(1.01,1.18)	1.09	(0.97,1.23)	1.06	(0.92,1.22)
25 000–35 000	0.89	(0.82,0.97)	1.12	(1.05,1.20)	1.14	(1.05,1.23)	1.14	(1.02,1.27)
35 000–50 000	0.80	(0.75,0.85)	1.20	(1.11,1.29)	1.22	(1.10,1.35)	1.18	(1.04,1.34)
50 000–75 000	0.73	(0.68,0.78)	1.27	(1.18,1.36)	1.37	(1.23,1.53)	1.35	(1.20,1.52)
>75 000	0.54	(0.50,0.59)	1.53	(1.42,1.66)	1.67	(1.54,1.80)	1.69	(1.52,1.88)
Education (ref: incomplete high school)		1.00		1.00		1.00		1.00
High school	0.81	(0.76,0.86)	1.25	(1.18,1.32)	1.21	(1.09,1.35)	1.31	(1.17,1.47)
Attended college	0.62	(0.58,0.66)	1.51	(1.41,1.61)	1.49	(1.37,1.62)	1.51	(1.44,1.79)
College graduate	0.42	(0.39,0.45)	1.83	(1.73,1.94)	1.86	(1.73,2.00)	2.13	(1.97,2.30)
Race (ref: white)		1.00		1.00		1.00		1.00
Black	1.18	(1.11,1.26)	0.81	(0.76,0.86)	1.14	(1.06,1.21)	1.10	(1.03,1.18)
Asian	1.80	(1.64,1.97)	0.56	(0.52,0.61)	0.74	(0.68,0.81)	0.65	(0.59,0.72)
Native	1.13	(1.02,1.24)	1.01	(0.91,1.12)	1.22	(1.08,1.39)	1.22	(1.05,1.42)
Hispanic	1.26	(1.16,1.37)	0.79	(0.74,0.85)	0.95	(0.88,1.04)	0.93	(0.84,1.03)
Other	1.04	(0.94,1.14)	1.05	(0.98,1.12)	1.20	(1.11,1.29)	1.19	(1.07,1.32)
Marital status (ref: coupled)		1.00		1.00		1.00		1.00
Single	0.93	(0.90,0.96)	1.12	(1.09,1.15)	1.31	(1.26,1.37)	1.28	(1.23,1.33)
Setting (ref: Rural)				1.00		1.00		1.00
Urban	0.92	(0.87,0.96)	1.04	(1.00,1.08)	1.16	(1.10,1.23)	1.16	(1.09,1.22)
Suburban	0.94	(0.88,1.00)	1.01	(0.95,1.07)	1.11	(1.05,1.16)	1.07	(1.01,1.14)

Continued

Table 3 Continued

	No physical activity		*Aerobic activity*		*Strengthening activity*		*Overall physical activity*	
	OR	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*
Number of poor mental health days in the past 30 days (ref: none)	1.00		1.00		1.00		1.00	
1 week	0.95	(0.89,1.01)	0.96	(0.89,0.99)	0.97	(0.92,1.04)	0.94	(0.87,1.01)
2 weeks	1.27	(1.19,1.36)	0.79	(0.73,0.87)	0.81	(0.77,0.85)	0.73	(0.68,0.78)
3 weeks	1.48	(1.37,1.60)	0.65	(0.60,0.70)	0.75	(0.70,0.81)	0.64	(0.59,0.70)
4 weeks	1.95	(1.80,2.11)	0.57	(0.53,0.61)	0.71	(0.64,0.78)	0.60	(0.52,0.69)

20% in the mid-2000s.[29] Smaller households are less able to benefit from the savings associated with pooling resources and sharing expenditures.[29] Since single-headed households with children are more likely to be headed by mothers, women are more likely to be detrimentally affected by the loss of pooled resources. Limited income and having greater responsibility as a single parent may potentially act as barriers for women to be physically active.

Limitations of this study

This study's results should be interpreted in the context of the following limitations. The study design was cross-sectional and therefore cannot determine temporality between exposure of interest and the physical activity outcomes. Also, the measurement of physical activity behavior was carried out by self-report and not measured objectively. That said, the results were generally consistent across the several indicators of physical activity studied. Another limitation is that we could not evaluate income inequality at smaller area units, such as the neighborhood or county. Smaller area units are more proximal to the individual and characteristics at this level might have more of an impact on health behavior. However, robust findings between income inequality and chronic disease health outcomes have been observed at the state level.

In conclusion, our study suggests that state-level income inequality is related to physical activity among women independent of sociodemographic and state-level characteristics. Further investigation is required in order to determine why women but not men are likely to fail to achieve CDC recommendations in more unequal states as well as mechanisms for the association between income inequality and physical activity.

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