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Social determinants of physical inactivity in the Northern Manhattan Study (NOMAS)

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Abstract

Background—Physical inactivity is an important and modifiable cardiovascular disease risk factor. Little is known about the social determinants of physical inactivity in older, urban-dwelling populations.

Methods—We collected socio-demographic and medical risk factor information and physical activity questionnaires in the Northern Manhattan Study. Logistic regression models were constructed to examine whether measures of social isolation, race-ethnicity, and sex were associated with physical inactivity.

Results—Physical inactivity was present in 40.5% of the cohort. In multivariable models adjusted for medical comorbidities, Hispanic race-ethnicity (compared to non-Hispanic white) was associated with higher odds of physical inactivity (OR 2.18, 95% CI 1.78, 2.67), while women were more likely to be inactive than men (OR 1.33, 95% CI 1.15, 1.54). Having Medicaid/being uninsured (OR 1.20, 95% CI 1.02, 1.42), and having fewer than 3 friends (1.41, 95% CI 1.15, 1.72) were also associated with physical inactivity.

Conclusions—Physical inactivity is common, particularly in Hispanics, women, and those who are socially isolated. Public health interventions aimed at increasing physical activity in these more sedentary groups are required.

Introduction

Physical inactivity is an important modifiable risk factor for cardiovascular disease (1). Physical activity decreases with age. Thus far several studies have examined the association between physical activity and cardiovascular disease, with some results indicating a protective effect independent of established risk factors such as diabetes and hypertension(1–6). Interventions to slow the decline in physical activity in the elderly have included exercise programs(7), but these may be difficult to implement in urban populations with poor access to appropriate indoor exercise facilities or sufficient outdoor space.

Determinants of physical inactivity in elderly urban populations are important to characterize before effective public health interventions can be performed. One European study found that increasing age, obesity, low educational attainment, widowhood or divorce, and smoking were associated with physical inactivity(8). In another, physical inactivity was more common in older individuals, women, African-Americans and Hispanics, urban dwellers, and in the less affluent(9). The physically inactive were also more likely to report poorer quality of life and health. In analyses of the National Health and Nutrition Examination Survey (NHANES) and the National Physical Activity and Weight Loss Survey, African-Americans, Hispanics, women, and older persons(10,11) were less likely to be physically active; these associations remained in NHANES after adjusting for family income, occupation, and poverty (12). Little is known the impact of social resources such as social isolation on physical inactivity in ethnically diverse urban populations. The goals of this cross-sectional study were to examine the determinants of physical inactivity in residents of Northern Manhattan, an urban, multi-ethnic population.

Methods

Recruitment of the Cohort

The Northern Manhattan Study (NOMAS) is a population-based prospective cohort study designed to evaluate the effects of medical, socio-economic, and other risk factors on the incidence of vascular disease in a stroke-free multi-ethnic community cohort. Participants were identified by dual-frame random digit dialing in the Northern Manhattan community, as previously described(13,14). Participants were eligible if they met the following criteria: (1) had never been diagnosed with a stroke; (2) were over the age of 39 years; and (3) resided in Northern Manhattan for ≥ 3 months in a household with a telephone. Households were contacted between 1993 and 2001, and of 5314 individuals initially eligible, a total of 3298 participants were recruited. In-person evaluations were performed at Columbia University Medical Center (CUMC) or at home for those who could not come in person (6% were done at home). The study was approved by the Institutional Review Board at CUMC. All participants gave informed consent to participate in the study.

Cohort Evaluation

Data regarding baseline status and risk factors were collected through interviews of participants by trained bilingual research assistants. Physical and neurological examination, in-person measurements, and analysis of fasting blood specimens were carried out by study physicians. Race-ethnicity, primary language spoken at home, and number of year living in the community were determined by self-identification. Standardized questions were adapted from the Behavioral Risk Factor Surveillance System by the Centers for Disease Control and Prevention regarding the following conditions: hypertension, diabetes, hypercholesterolemia, peripheral vascular disease, transient ischemic attack, cigarette smoking, and cardiac conditions(15). Depression was defined as a score of at least 10 on the Hamilton Depression Scale(16). We asked further questions at enrollment to characterize participants' social networks, including whether they had 3 or more friends, were married, or had fewer than 2 visitors at home. Standard techniques were used to measure blood pressure, height, weight, and fasting serum glucose and lipid panels. Hypertension was defined as systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg based on the average of two blood pressure measurements, a physician diagnosis of hypertension, or a patient's self-report of a history of hypertension or anti-hypertensive use. Diabetes mellitus was defined as fasting blood glucose ≥ 126 mg/dl or the patient's self-report of such a history, or insulin or hypoglycemic agent use.

Physical activity was measured by an in-person questionnaire adapted from the National Health Interview Survey of the National Center for Health Statistics(17). This questionnaire records the duration and frequency of various leisure time/recreational activities for the 2 weeks before the interview is carried out. The participants were also asked if this level of activity was typical of other weeks. An outline of the questions asked is provided in the figure. The participants were also asked if they engaged in any physical activity in the preceding two weeks, and those who answered “no” were coded as physically inactive. This questionnaire has been previously validated in this same population, demonstrating a crude concordance rate of 0.69 when proxies of the participants were asked. This same measure also correlated with body-mass index (BMI), activities of daily living scores, and activity scores on a quality of well-being scale (18).

Statistical Analysis

Univariate analyses using the Pearson chi-square statistic were performed to determine associations between demographic and medical co-morbidities and physical inactivity, and odds ratios (OR) were calculated using contingency table methods. Logistic regression models were used to calculate ORs for physical inactivity according to socio-demographic factors (race-ethnicity, medical insurance status, high school education, speaking English as a first language), social isolation measures (<3 friends, having no visitors at home, being unmarried), and medical co-morbidities (depression, hypertension, diabetes mellitus, dyslipidemia, coronary artery disease, peripheral vascular disease, tobacco use and chronic obstructive pulmonary disease). Socio-demographic factors were kept in all models, while medical co-morbidities were excluded if they were not associated with physical inactivity in univariate analyses ($P > 0.05$).

Results

Baseline demographics of the cohort are presented in table 1. The average age was 69.2 $\pm$ 10.3 years, and 62.9 % were women; 54.2 % of the cohort was Hispanic, 25.0 % non-Hispanic black, and 20.8 % non-Hispanic white.

Physical inactivity was common in the cohort (40.8% overall), but differed by race-ethnicity. Hispanics were more likely to be physically inactive (48.4%) and less likely to engage in moderate-heavy intensity activity (14.6%) compared to whites (30.7% physically inactive, 28.2% participated in moderate-heavy intensity activity). There were significant differences by sex in the baseline physical activity characteristics as well. Women were more likely to be physically inactive versus men (43.3% versus 36.5 %), and to engage less in moderate-heavy intensity activities (Table 2).

In univariate analyses physical inactivity was associated with diabetes, hypertension, peripheral vascular disease, and heart disease. Several socio-demographic variables were associated with physical inactivity, including not being a primary English speaker, having less than 3 friends, having less than 2 visitors at home per week, depression, and not completing a high school education (Table 3). In multi-variable models adjusted for medical co-morbidities and demographics, Hispanics (compared to non-Hispanic whites) were more likely to be physically inactive (adjusted OR 2.18, 95% CI 1.78, 2.67), while women were more likely to be inactive (adjusted OR 1.33, 95% CI 1.15, 1.54). Having Medicaid/being uninsured (adjusted OR 1.2, 95% CI 1.02, 1.42), having fewer than two visitors per week (adjusted OR 1.22, 95% CI 1.05, 1.41), not completing a high school education (adjusted OR 1.22, 95% CI 1.03, 1.45), depression (adjusted OR 1.64, 95% CI 1.24, 2.18), and having fewer than 3 friends (adjusted 1.41, 95% CI 1.15, 1.72) (table 3) were associated with physical inactivity after adjusting for medical risk factors. There was no longer an

association between English being the first language or marital status and being physically inactive after adjusting for medical risk factors.

The associations between Hispanic ethnicity and sex and physical inactivity remained statistically significant in all models and were not appreciably different after adjusting for other factors. In a model including all medical and sociodemographic factors, Hispanic ethnicity (adjusted OR 1.69, 95% CI 1.28, 2.23), female sex (adjusted OR 1.25 95% CI 1.06, 1.47), depression (adjusted OR 1.63, 95% CI 1.23, 2.16), and having fewer than 3 friends (OR 1.30, 95% CI 1.05, 1.59) were associated with physical inactivity.

There was evidence for an interaction between having at least 3 friends and Hispanic race-ethnicity (P value for interaction = 0.03). We therefore carried out analyses stratified by number of friends, and noted that Hispanics with fewer than 3 friends had a higher odds of being physically inactive (adjusted OR 1.97, 95 % CI 1.02, 3.79). The odds of physical inactivity among Hispanics was blunted slightly among those who had at least 3 friends (adjusted OR 1.69, 95% CI 1.25, 2.30).

Discussion

Physical inactivity was very common, approximately 40%, in this older, urban-dwelling, multi-ethnic cohort. This is alarming given the association between physical inactivity and multiple health problems of the elderly such as dementia, coronary heart disease, and all-cause mortality(19,20). Women and Hispanics were particularly likely to be physically inactive, as were those who were socially isolated. These associations were present even after adjusting for socio-economic status and markers of social isolation.

Several studies in multiple countries have identified women as being more likely to be physically inactive. Other investigators have found that physical activity recommendations in Caribbean-Hispanic women in New York were met by only 11%(21). Physical inactivity appears to start in teenage years, and persists into adulthood (22,23). Educational achievement may be a strong determinant of leisure-time physical activity(24), either through improved economic resources or knowledge of the benefits of exercise, and this could be an additional explanation for our findings. Data from the BRFSS noted that the prevalence of physical inactivity was highest in women, and across all race-ethnic groups. Encouragingly from 1994 to 2004 there were fewer women who were physically inactive, particularly in the 60 to 69 age groups where the prevalence of physical inactivity dropped from 37.8 % to 28.5 % (25). The reasons for why women are more likely to be physically inactive may be related to societal norms or pressures, or the nature of employment for men versus women.

Hispanics have been previously identified in the BRFSS as having a higher prevalence of physical inactivity(11). This has important public health implications given that they are the fastest growing segment of the population in the United States. Temporal trends have indicated that Hispanics have had a drop in the prevalence of physical inactivity from 1994 to 2004, with Hispanic men dropping from 37.5% to 32.5 % and women dropping from 44.8% to 39.8 %; the gains however were more modest compared to whites (men dropped from 26.4 % to 18.4 %, and women dropped from 28.3 % to 21.6 %)(25). Part of the explanation for these findings has been higher work related physical activity in Hispanics, and language and cultural differences. In the 4-Corners Breast Cancer Study investigators found that Hispanic women had a higher prevalence of leisure-time physical inactivity, and were more likely to report activity from housework or dependant care. Hispanic women however who had a greater degree of language acculturation were more likely to have trends that were similar to white women(26). Language and acculturation appear to be an

incomplete explanation for our findings since we found no evidence of an interaction between Hispanic ethnicity and primary language or years of residence in the United States. We found that blacks were not more likely to be physically inactive than whites, which differs from the BRFSS and the Minnesota heart survey (25,27). Others have found that the differences in physical activity stem from educational achievement and SES (28), which is unlikely to be a complete explanation for our findings given there was no association in univariate or multi-variable analyses between physical inactivity and race. Our findings could be in part related to how our participants were enrolled: blacks who chose to participate in our study may not have been representative of the source population in northern Manhattan.

Physical inactivity was most likely in our participants with markers of social isolation, specifically as related to networks of friends. We found that the association between having fewer than 3 friends and being physically inactive remained after adjusting for both medical and all socio-demographic factors, including depression. This may reflect the fact that leisure-time physical activity is often a social phenomenon, in which groups of friends participate together. There was also evidence of an interaction between Hispanic ethnicity and social isolation, pointing to the fact that exercise could be a particularly social phenomenon in Hispanics. In our study, markers of lower socioeconomic status, such as level of education and insurance status, were also associated with a higher risk of physical inactivity, consistent with several prior studies(10,12,21,24,29,30), including one focused on older populations(31). Individuals with lower socio-economic status appear to have greater barriers to exercise, either self-perceived(32), or perhaps due to the economic loss stemming from the cost of exercise facilities and equipment, or due to wages lost while exercising. The trends in our population reflect those in the United States, where physical activity increases with income (33). Lower socio-economic status is a known risk factor for cardiovascular disease(34). Medical co-morbidities were also not associated with physical inactivity.

Interestingly we found no association between marital status and physical inactivity, which runs counter to the findings by other investigators (35). In our case-control study, we found that friend networks were independently associated with a risk of recurrent stroke, while marital status was not(36). It may be that different social support networks support different behaviors; the social network of friends may be more important in the control of risk factor such as physical inactivity, while a spouse is more important in preparedness(36). We also found that not speaking English at home was not associated with physical inactivity, also counter to others who have found that English-speaking Hispanics are more likely to be physically active(37).

Our study has several weaknesses. In this analysis we only used reported physical activity, and not objective measures of physical activity. Our cross-sectional design does not allow for describing causal relationships for physical inactivity and socio-demographic factors. Being physically unfit for example may lead to individuals remaining home bound or not engaging in social activities with others. We did not collect information on how well medical co-morbidities were controlled, or on actual income, so we are not able to adjust for these factors. On the other hand our study does include a large sample of urban dwellers with extensive questions on social-demographic factors. We did not collect information regarding attitudes and beliefs towards exercise and the potential health benefits, or on time constraints to exercise, which have been previously identified as important predictors of physical inactivity(38–40). Data were also not available on other important barriers to physical activity, including neighborhood safety, and employment related physical activity. Leisure time physical activity may be particularly important in the prevention of cardiovascular disease, independently of other activity (3).

We are also unable to investigate in our current analysis whether by describing physical inactivity we are in fact addressing a broader issue of general health well-being or abnormal aging. Physical inactivity has been described as an integral component of several of the definitions used for the concept of frailty(41). A working definition used in the Cardiovascular Health Study and the Women's Health and Aging Study included being physically inactive as one of the 5 components of frailty, which in itself has been correlated with several adverse health outcomes (42,43). Life-space constriction, one marker of social isolation, has been associated with the presence of frailty, and may be a correlate of some of our results(44). Addressing physical inactivity may thus help with not only prevention of cardiovascular disease outcomes, but with the development of frailty(7).

Our findings may represent an important component in trying to identify populations vulnerable to the development of physical inactivity: it appears that women, Hispanics, and those who are socially isolated are populations that should be targeted for intervention. Facilities and structured programs for exercise which are free are less likely to be available for those who live in urban areas with a lower SES(45). Given the benefits that even moderate increases in physical activity have on cardiovascular disease(46), and on all cause mortality even when it is initiated in those over the age of 70(20), these programs would be of clear benefit in vulnerable populations such as ours, and should be expanded. The means for doing so will require understanding which individuals are more likely to use community resources, such as senior centers, and which will need more individualized approaches. Community interventions, such as a successful program in Brazil using free to the participant leisure-time physical activity sessions, will require partnerships between community groups, senior centers, religious organizations, health-care providers, and government agencies(47). These types of initiatives may also help to offset the risk that social isolation and a constricted living space create on physical inactivity.

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In the past 14 days, have you participated in any recreational or leisure-time activities, such as exercises, sports, or physically active hobbies?

Was the amount of time you spent participating in recreational or leisure time activities and the type of activities you performed in the past 14 days typical of your recreational physical activity throughout the year?

On average, how many times in the typical 14 day period do you do this activity?

Estimate how many minutes you actually spend on each occasion?

1. Walking for exercise?
2. Jogging or running?
3. Hiking?
4. Gardening or yard work?
5. Aerobics or aerobic dancing?
6. Other dancing?
7. Calisthenics or general exercise?
8. Golf?
9. Tennis?
10. Bowling?
11. Bicycle riding?
12. Swimming or water exercises?
13. Horseback riding?
14. Handball, racquetball, or squash?
- 15a. Have you done any other exercises, sports, or physically active hobbies in the past 2 weeks other than the ones listed above?
- 15b. What were they?

Figure.
Physical activity questionnaire used in the Northern Manhattan Study

Table 1

Baseline demographics of the Northern Manhattan Study Cohort (n = 3298).

Socio-demographic characteristics		Mean and SD or n (%)
Age		69.2 (standard deviation 10.3 years)
Women		2072 (62.8 %)
Race-Ethnicity		
	Hispanic	1725 (52.3 %)
	Non-Hispanic Black	803 (24.4 %)
	Non-Hispanic White	691 (21.0 %)
Less than high school education		1786 (54.2 %)
Medicaid or no insurance		1435 (43.8 %)
Medical Co-morbidities		
Tobacco use	Never used	1548 (47.0 %)
	Former smoker	1179 (35.8 %)
	Current user	569 (17.2 %)
Alcohol use	Never/light	1242 (37.7 %)
	Mild-moderate *	1075 (32.7 %)
	Heavy	170 (5.2%)
Hypertension	Hypertension diagnosis [†]	2429 (73.7 %)
	Mean Systolic and Diastolic blood pressures	143/80 (standard deviation 21/11) mm Hg
Diabetes mellitus ^{††}		715 (21.7 %)

* Moderate alcohol use = 1–2 servings of alcohol per day

[†] Hypertension = Systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg based on the average of two blood pressure measurements, a physician diagnosis of hypertension, or a patient's self-report of a history of hypertension or anti-hypertensive use.

^{††} Diabetes mellitus was defined as fasting blood glucose ≥ 126 mg/dl, the patient's self-report of diabetes mellitus, or insulin and/or hypoglycemic agent use.

Table 2

Baseline physical activity characteristics in the Northern Manhattan Study

	Physically inactive (n = 1346)	Light intensity activity [†] (n = 1303)	Moderate-Heavy intensity activity ^{††} (n = 649)
Overall (n = 3298)	40.8 %	39.5 %	19.7 %
Men (n = 1226)	36.5 %	40.5 %	22.9 %
Women (n = 2072)	43.3 %	38.9 %	17.8 %
Whites (n = 691)	30.7 %	41.1 %	28.2 %
Hispanics (n = 1725)	48.4 %	37.0 %	14.6 %
Blacks (n = 803)	33.6 %	43.9 %	22.5 %

[†] Light intensity physical activity includes, for examples, golf, walking for exercise, dancing.

^{††} Moderate-heavy intensity physical activity includes, for examples, hiking, tennis, swimming, bicycling, jogging, racquetball.

Table 3

Risk factors for physical inactivity in the Northern Manhattan Study

Risk factor	Univariate OR (95% CI)	Multivariable OR (95% CI)*	Multivariable OR (95% CI) †
Not speaking English as a first language at home	1.75 (1.52–2.04)	1.20 (0.93–1.56)	1.14 (0.87–1.49)
Having fewer than 3 friends	1.49 (1.22–1.79)	1.41 (1.15–1.72)	1.27 (1.03–1.56)
Married (excluding divorced, separated and widowed)	0.99 (0.85–1.15)	1.08 (0.91–1.27)	1.11 (0.94–1.31)
Not completing a high school education	1.79 (1.56–2.04)	1.22 (1.03–1.45)	1.19 (1.00–1.42)
Insurance (Medicaid or being uninsured versus all others)	1.68 (1.46–1.93)	1.20 (1.02–1.42)	1.14 (0.96–1.36)
Depression	1.98 (1.52–2.58)	1.70 (1.29–2.26)	1.63 (1.23–2.16)
Having less than 2 visitors at home	1.24 (1.08–1.43)	1.22 (1.05–1.41)	1.15 (0.99–1.34)
Hispanic (reference White)	2.12 (1.76–2.56)	2.18 (1.78–2.67)	1.69 (1.28–2.23)
African American (reference White)	1.14 (0.92–1.41)	1.08 (0.86–1.35)	1.14 (0.88–1.46)
Female sex	1.33 (1.15–1.54)	1.23 (1.05–1.43)	1.25 (1.06–1.47)

* Adjusted for age, sex, race-ethnicity, chronic obstructive pulmonary disease, peripheral vascular disease, heart disease, BMI greater than 30, diabetes, hypertension, and light-moderate alcohol intake. Not adjusted for the other socio-demographic variables listed as risk factors.

† Fully adjusted model including all socio-demographic and medical factors