The impact of socioeconomic status and social deprivation on musculoskeletal limitations

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ABSTRACT

Background: Objective (SES) and subjective socioeconomic status (SSS) affect symptom intensity and magnitude of limitations. Identification of potentially modifiable social risk factors might contribute to additional opportunities for optimizing musculoskeletal health.

Questions/purposes: (1) There are no correlations between magnitude of limitations (as measured with Patient-Reported Outcomes Measurement Information System Physical Function [PROMIS PF computer adaptive test]) and components of SES or SSS in people with musculoskeletal disease; (2) There are no factors (including level of social deprivation) independently associated with PROMIS PF.

Methods: One hundred and fifty-nine patients presenting to clinicians specializing in the treatment of a broad variety of musculoskeletal conditions were prospectively enrolled in the study. We recorded patient demographics and assessed patients' socioeconomic status using the MacArthur Sociodemographic questionnaire and physical disability rating using PROMIS PF. Patients deprivation index was retrieved using their 9-digit ZIP codes. We used bivariate analysis to determine correlations between magnitude of limitations and socioeconomic status. We created a stepwise backward multivariable linear regression model to assess factors independently associated with PROMIS PF.

Results: Weak correlations were found on bivariate analysis of PROMIS PF with SSS measured as “Place in community” (r 0.28; $P < 0.001$) and “Place in the United States of America” (r 0.25; $P = 0.002$). In the multivariable models, the area deprivation index was not independently associated with physical limitations. Male gender (beta regression coefficient [β] 4.1; 95% CI 0.71 to 7.5; $P = 0.018$) and having net worth of \$5000 - \$19,999 (β 6.3; 95% CI 0.35 to 12; $P = 0.038$) or \$20,000 - \$99,999 (β 5.8; 95% CI 2.1 to 9.5; $P = 0.003$) when compared to having net worth of less than \$4999 were independently associated with better physical function. Being unemployed or disabled and keeping house, being a student, or retired were independently associated with worse physical function (β -12; 95% CI -18 to -7.0; $P < 0.001$; β -5.6; 95% CI -9.9 to -1.4; $P = 0.009$, respectively), when compared to working full-time or part-time.

Conclusions: Objective and subjective measures of socioeconomic status are associated with magnitude of physical limitations in patients with musculoskeletal illness. These factors should be considered when developing treatment plans for patients with musculoskeletal conditions.

Level of evidence: Level II prognostic study.

1. Introduction

Patient-reported outcome measures (PROMs) quantify illness (symptom intensity and magnitude of limitations). The Patient-Reported Outcomes Measurement System (PROMIS) Physical Function

(PF) computer adaptive test is a PROM based on item-response theory that assesses physical limitations and is scaled to population norms and has little to no ceiling or floor effects.^{1–3} For a given disease (objective pathophysiology) there is wide variation in symptom intensity and magnitude of limitations. A substantial amount of this variation in

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illness is accounted for by differences in mental and social health.^{4,5} Identification of opportunities for improving musculoskeletal health by addressing social determinants of health has the potential to improve physical function, with or without intervention.

Unlike objective socioeconomic status (SES), traditionally assessed using a person's education, occupation and income, subjective socioeconomic status (SSS) is defined as “a person's subjective perception of their rank, relative to others, in the socioeconomic hierarchy”.⁶ SSS may better account for a more diverse set of current and future markers of SES.^{7–12} SES and SSS are both associated with lower scores on a general health patient-reported outcome (the SF-36).^{7,8} Greater monthly disposable household income and greater value of household possessions are associated with higher self-rated health.¹³ Socioeconomic status, specifically SSS, is associated with variation in magnitude of physical limitations by socioeconomic class.^{14,15} Regions where the most marginalized populations live often have a greater burden of illness and this is often paired with less access to care.¹⁶ This may lead to progression or exacerbation of disease, greater distress, and less effective coping strategies all contributing to diminished health. Social deprivation is associated with worse physical function, as measured with the Short Physical Performance Battery and the Health Assessment Questionnaire.^{17–20} Furthermore, patients who lived in a more socially deprived community, measured using the Distressed Communities Index (DCI) that combines 7 socioeconomic variables to estimate a community's socioeconomic distress using ZIP codes, were more likely to experience major complications.²¹ Patients were more likely to experience major complications after surgery with an odds ratio of 1.1 per quartile increase in DCI.²¹ Improvements in social health may alleviate musculoskeletal symptoms and limitations.

This study assessed the association of SES and SSS with magnitude of physical limitations (measured with PROMIS PF). Specifically, the primary null hypothesis was that there is no correlation between magnitude of limitations and SSS and SES among patients with a musculoskeletal disease. Our secondary hypotheses aimed to assess the level of social deprivation independently associated with magnitude of limitations.

2. Methods

2.1. Study design and setting

After institutional review board approval, 159 new and returning adult (aged 18–89 years old), English or Spanish speaking patients presenting to clinicians specializing in the treatment of a broad variety of musculoskeletal conditions of the upper- and lower extremity were invited to participate. Patients were approached in the outpatient clinic setting in a large urban area in conjunction with their specialist appointment to participate in this cross-sectional study over a two-month period. All questionnaires were administered on an encrypted tablet via a secure, HIPAA-compliant electronic platform called REDCap (Research Electronic Data Capture Application) that is a web-based tool for building and managing online surveys and databases).¹⁴ Completion of the questionnaires indicated consent. Three patients (1.9%) were not interested in participating, leaving 156 for analysis.

2.2. Outcome measures

Subjects completed a demographic questionnaire, the MacArthur Sociodemographic questionnaire, and PROMIS PF. The demographic questionnaire consisted of 9-digit ZIP code, gender, marital status, race/ethnicity, insurance status, traumatic vs non-traumatic condition, comorbidities (diabetes, musculoskeletal, cardiovascular, pulmonary, other), smoker status, length, and weight (to calculate body mass index; BMI). PROMIS PF served as our proxy for physical disability (i.e. limitations of physical activity), as its questions detail the extent to which patients can complete daily household activities and other tasks requiring physical labor of various degrees.

2.3. Measurements

The MacArthur Sociodemographic questionnaire is a 17-item questionnaire that aims to assess subjective- and objective socioeconomic status. SSS is tested using two ladders as visual analogue scales. People compare themselves to others in terms of their self-defined standing in their community and their standing in the United States whilst taking education, money, and jobs into consideration. SSS was measured from 0 to 10 on a sliding scale, with a higher score indicating a higher standing.²² SES is rated using a variety of multiple-choice questions on income, household composition, education and profession.^{11,22,23} The sociodemographic questionnaire additionally assesses SES variables like highest education grade completed, the total number of people living in household, number of people living in the household with income, total combined family income, and financial assets (defined as the combined value of all of patients (and their spouse's) checking and savings accounts, and any stocks and bonds). Net worth was defined as financial assets minus any debt (credit card debt, unpaid loans including car loans, home mortgage).²²

The Area Deprivation Index (ADI) uses the 9-digit ZIP-code to rank neighborhoods by socioeconomic deprivation when compared to state level or national level of social deprivation. Data from the American Community Survey in 2013 was used to create the index. It is a multi-dimensional measure of deprivation that accounts for factors like education, employment, housing quality and income. National rankings extend from 1 to 100 in percentiles, and from 1 to 10 in deciles for states. Higher ADI rankings indicate neighborhoods to be more disadvantaged.²⁴

PROMIS PF uses computerized adaptive testing based on item response theory to fit the most appropriate series of questions for each person based on their preceding responses. It uses a minimum of 4 and a maximum of 12 questions and measures limitations of physical activity.²⁵ Items are scored on a 5-point Likert scale. Higher scores indicate better physical function (fewer limitations of physical activity). PROMIS PF is typically completed in less than a minute and has little or no ceiling or floor effects.^{21,26,27}

2.4. Patient characteristics

Our study sample consisted of 156 participants (82 men; 53%), with a mean age of 50 ± 16 years (Table 1). Most persons were white ($N = 109$; 70%) and married or in a domestic partnership ($N = 77$, 51%) and with private insurance ($N = 94$; 60%). Fifty (32%) participants had an income of \$75,000 or greater (Table 2). Mean ADI was 3.1 ± 2.4 when ranked state-specific and 39 ± 26 when compared to national levels of disadvantage whereas mean “place in community” was 62 ± 18 and mean place in the USA was 62 ± 20 . Mean PROMIS PF score was 45 ± 9.9 .

2.5. Statistical analysis

Continuous data are presented as mean $\pm$ standard deviation (SD) with range and discrete variables as numbers and percentages. We used Pearson's correlation coefficient to compare continuous variables, Student's t-test for continuous and dichotomous variables, and one-way analysis of variance (ANOVA) for nominal and continuous variables. We created a stepwise backward multivariable linear regression model to assess factors independently associated with PROMIS PF (Table 3). We included all factors with $P < 0.10$ on bivariate analysis (Appendix 1). Semi-partial R-squared (R^2) expresses the specific variability of a given independent variable in the model and adjusted R^2 indicates the amount of variability explained for PROMIS PF. An a priori power analysis indicated that a minimum a sample size of 136 participants would provide 80% statistical power with a small to medium effect size of 0.15, for a regression with 5 predictors. To account for 15% incomplete responses, we enrolled 156 patients.

Table 1
Patient characteristics.

Variables	N = 156
Age in years ¹	50 ± 16 (18–81)
Men	82 (53)
BMI ¹	30 ± 7.3 (17–54)
Race/Ethnicity	
White	109 (70)
Non-white	47 (30)
Marital status ¹	
Married	77 (51)
Single	42 (28)
Separated/Divorced/Widowed	33 (22)
Insurance	
Private	94 (60)
Medicare	24 (15)
Other	33 (21)
None	5 (3.2)
Trauma	53 (34)
Smoking	9 (5.8)
Comorbidities	
Diabetes	17 (11)
Musculoskeletal disease	30 (19)
Cardiovascular disease	27 (17)
Pulmonary	2 (1.3)
Other	27 (17)
ADI ¹	
State-specific	3.1 ± 2.4 (1–10)
National	39 ± 26 (1–100)
PROMIS PF ¹	45 ± 9.9 (24–76)

Continuous variables as mean ± standard deviation (range); Discrete variables as number (percentage); BMI = Body Mass Index (kg/m²); ADI = Area Deprivation Index: National (percentile of block group ADI score); State-specific (decile of block group ADI score); PROMIS PF = Patient-Reported Outcomes Measurement Information System Physical Function; ¹ N = 155 for age, 151 for BMI, 152 for marital status, 139 for state specific and national ADI, 154 for PROMIS PF.

3. Results

3.1. Correlation between SSS and SES with physical function

For SSS, “Place in community” (r 0.28; P < 0.001) and “Place in the United States of America” (r 0.25; P = 0.002) had weak correlations with PROMIS PF (Appendix 1).

For objective SES, state-specific ADI (r −0.16; P = 0.062) did not correlate with PROMIS PF. ADI, when compared to national level of social deprivation, had a weak negative correlation with PROMIS PF (r −0.19; P = 0.024).

3.2. Factors associated with physical function

Using stepwise backward multivariable linear regression analysis to account for potential confounding, ADI was not retained in the final model of factors associated with PROMIS PF, but male sex (β 4.1; 95% CI 0.71 to 7.5; P = 0.018; semipartial R^2 0.01), and net worth of \$5000 - \$19,999 (β 6.3; 95% CI 0.35 to 12; P = 0.038; semi-partial R^2 0.02) or \$20,000 - \$99,999 (β 5.8; 95% CI 2.1 to 9.5; P = 0.003; semi-partial R^2 0.03; Adjusted R^2 full model 0.26) compared to net worth of less than \$4999 were independently associated with better physical function (Table 3). Being unemployed or disabled (β −12; 95% CI −18 to −7.0; P < 0.001; semipartial R^2 0.10) or keeping house, being a student or being retired (β −5.6; 95% CI −9.9 to −1.4; P = 0.009; semipartial R^2 0.03) when compared to working full-time or part-time were independently associated with worse physical function. In other words, unemployed or disabled patients had 12 points lower on PROMIS PF than working patients.

Table 2
MacArthur sociodemographic questionnaire.

Variables	N = 154
Place in community	62 ± 18 (0–100)
Place in the USA	62 ± 20 (0–100)
Highest education grade completed	
High school or less (grade 1–12)	36 (23)
(Some) College (grade 13–16)	79 (51)
(Some) Graduate or more (grade 17–20+)	39 (25)
Highest degree earned	
High school or equivalency (GED) or less	42 (27)
Associate degree (junior college)	14 (9.1)
Bachelor's degree	54 (35)
Masters degree	24 (16)
Doctorate or Professional	11 (7.1)
Other	9 (5.8)
Working status	
Working part-time/full-time	94 (61)
Keeping house/Student/Retired	42 (27)
Unemployed/Disabled	18 (12)
Personal income last 12 months	
Less than \$15,999	28 (18)
\$16,000 - \$34,999	24 (16)
\$35,000 - \$49,999	21 (14)
\$50,000 - \$74,999	20 (13)
\$75,000 and greater	50 (32)
Don't know/No response	11 (7.1)
People in household	
One	31 (20)
Two	58 (38)
Three	24 (16)
Four	25 (16)
Five or more	16 (11)
Adults in household	
One	40 (26)
Two	88 (57)
Three	18 (12)
Four or more	8 (5.2)
Children in household	
None	102 (66)
One	17 (11)
Two	24 (16)
Three or more	11 (7.1)
People in household with income	
None	8 (5.2)
One	71 (46)
Two	62 (41)
Three or more	12 (7.8)
Home	
Owned	103 (67)
Rented	41 (27)
Other	10 (6.5)
Total combined family income	
Less than \$15,999	13 (8.4)
\$16,000 - \$34,999	16 (10)
\$35,000 - \$49,999	11 (7.1)
\$50,000 - \$74,999	13 (8.4)
\$75,000 and greater	87 (56)
Don't know/No response	14 (9.1)
Amount of time able to live at current address and standard of living when all sources of family income are lost.	
Less than 1 month	22 (14)
1–2 months	19 (12)
3–6 months	27 (18)
7–12 months	14 (9.1)
More than 1 year	72 (47)
Financial assets	
Less than \$4999	33 (21)
\$5000 - \$19,999	19 (12)
\$20,000 - \$99,999	21 (14)
\$100,000 - \$499,999	27 (18)
\$500,000 and greater	31 (20)
Don't know/No response	23 (15)
Net worth	
Less than \$4999	58 (38)
\$5000 - \$19,999	11 (7.1)
\$20,000 - \$99,999	13 (8.4)

(continued on next page)

Table 2 (continued)

Variables	N = 154
\$100,000 - \$499,999	23 (15)
\$500,000 and greater	26 (17)
Don't know/No response	23 (15)

Continuous variables as mean $\pm$ standard deviation (range); Discrete variables as number (percentage).

4. Discussion

An improved understanding of the effect of SES and SSS on symptom intensity and magnitude of limitations might identify potentially modifiable factors that could alleviate symptoms and improve physical function. This study addressed the influence of objective and subjective measures of socioeconomic status on magnitude of physical limitations.

The results of this study should be interpreted with an awareness of several limitations. First, we analyzed a large number of variables, mainly because the MacArthur Sociodemographic questionnaire had 12 separate questions. To account for this, we checked for indications of collinearity (Appendix 2) and used stepwise backward regression analysis. Given the large number of socioeconomic variables significantly associated with each other and with PROMIS PF in bivariate analysis, we used stepwise regression, which may have overestimated R^2 and included fewer socioeconomic variables in the model because of correlation between variables. Second, the most recent ADI uses data from the 2013 American Community Survey, which may be out of date. This urban area is one of the fastest growing cities in the United States with an annual population growth rate approaching 3%.^{28,29} Additionally, median per capita income, household income, and sales price of homes are increasing.^{30,31} With this magnitude and pattern of growth, it is likely that the distribution of social disadvantage in this urban area has shifted, causing the ADI to be unrepresentative. In addition, there were 17 new zip codes since 2013 that represented missing values for ADI in the analysis. New neighborhoods in a rapidly developing city may be comprised of more socially advantaged individuals, thereby potentially skewing our results. Third, we did not account for the known influence of psychological factors on measures of symptoms and limitations, which may lead to an overestimation of the independent effect of socioeconomic factors on physical limitations. Fourth, our study addressed a general mix of people, all new and returning persons with a musculoskeletal condition presenting to a specialist in a relatively wealthy urban area. Among persons with specific pathophysiology, from other geographical areas, and at other specific times in the care continuum findings might be different. Fifth, low SES individuals were relatively unrepresented. The associations might be stronger in other populations.

Table 3

Stepwise multivariable regression analyses of factors associated with PROMIS PF CAT.

Dependent variables	Retained variables ¹	Regression coefficient [β] (95% CI)	Standard error (SE)	P value	VIF	Semipartial R^2	Adjusted R^2
PROMIS PF	Sex						0.26
	Women	Reference value					
	Men	4.1 (0.71–7.5)	1.7	0.018	1.0	0.01	
	Working status						
	Working part-time/full-time	Reference value					
	Unemployed/Disabled	–12 (–18 to –7.0)	2.8	< 0.001	1.0	0.10	
	Keeping house/Student/Retired	–5.6 (–9.9 to –1.4)	2.1	0.009	1.2	0.03	
	Net worth						
	Less than \$4999	Reference value					
	\$5000 - \$19,999	6.3 (0.35–12)	3.0	0.038	1.1	0.02	
	\$20,000 - \$99,999	5.8 (2.1–9.5)	1.9	0.003	1.2	0.03	

Bold indicates statistically significant difference; ¹ Only significant variables displayed; CI = Confidence interval; VIF = Variance Inflation Factor; PROMIS PF = Patient-Reported Outcomes Measurement Information System Physical Function; Variables applied to stepwise backward regression model ($P < 0.10$ on bivariate analysis): age, sex, BMI, marital status, insurance status, trauma, diabetes, musculoskeletal comorbidity, cardiovascular comorbidity, pulmonary comorbidity, other comorbidity; ADI = Area Deprivation Index national and state-specific, place in community, place in USA, level of education, work status, personal income, people in household, adults in household, children in household, people in household with income, total combined family income, amount of time able to live at current address and standard of living when all sources of family income are lost, financial assets, and net worth.

Our finding of a weak correlation between subjective socioeconomic status and physical limitations is consistent with prior studies.^{14,32} Although subjective ranking may not correspond precisely with objective SES, it might better incorporate past and future circumstances, which – in a way – may make it a type of composite and multidimensional measure of socioeconomic status.¹¹ Prior studies found that higher subjective socioeconomic status is associated with greater self-rated health as measured on a 5-point Likert scale or 10-rung self-anchoring scale.^{10,11}

Social deprivation as measured using ADI was not independently associated with greater physical limitations in this study. Prior research with people with a similar SES distribution found that residents who live in more deprived neighborhoods had a diminished physical function (e.g. mobility difficulties, like walking 100 yards).^{17–20} An updated ADI or a population with patients of lower SES might have shown larger correlations. On the other hand, working status (unemployed, disabled, housekeeping, being a student or being retired) and lower net worth were independently associated with greater limitations of physical activity. This is in line with prior research finding associations between components of objective socioeconomic status and physical limitations. Lower level of education, lower per capita and household income, lesser working status and fewer financial assets associated with greater limitations of physical activity as measured by aerobic endurance, gait speed, lower body strength, the performance-oriented mobility assessment, and limitations in instrumental activities of daily living and activities of daily living.^{14,15,33,34}

Our findings emphasize the effect of perceived and objective socioeconomic status on physical limitations. Clinicians and policymaker awareness of these influences can lead to better models of care and improved health. Clinicians might consider accounting for SES and measuring SSS when helping patients with a musculoskeletal disease get and stay healthy. Awareness of the influence of social health on symptoms and limitations might influence clinicians to rely less on low yield tests and discretionary interventions with inconsistent, debated, or limited effects on patient-reported outcomes. This is particularly relevant given the growing number of operative procedures that do not outperform non-operative or sham treatments in randomized trials.^{35–37} It also runs counter to current financial incentives and to the hope that people seeking care often place on passive, powerful other approaches to health, which might affect satisfaction scores, recommendations to acquaintances, and referring clinicians. Nevertheless, this study adds to the mounting evidence that the focus in musculoskeletal health might increasingly be on comprehensive care, opening a dialogue with a broader care team that prioritizes attention to mental and social health. Areas for future studies include the influence of psychological factors (e.g. symptoms of depression or the effectiveness of coping strategies)

on SSS, and the ability of interventions to improve social health to alleviate symptoms and improve function in people with musculoskeletal illness.

Author contribution

LR, JK, DB, JZ, and SG certify that they have no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

KB has or may receive payment or benefits in the form of: Grants from Agency for Healthcare Research and Quality (AHRQ), grants from California Public Employees' Retirement System (CalPERS), personal fees from Harvard Business School, personal fees from Centers for Medicare and Medicaid Services, other from American Joint Replacement Registry (AJRR), grants from the Agency for Health Care Research & Quality (AHRQ), other from American Academy of Orthopaedic Surgeons (AAOS), other from American Association of Hip and Knee Surgeons (AAHKS), other from Orthopaedic Research and Education Foundation (OREF), and personal fees from Carrum Health.

DR has or may receive payment or benefits from Skeletal Dynamics, Wright Medical for elbow implants, Deputy Editor for Clinical

Orthopaedics and Related Research, Universities and Hospitals, Lawyers outside the submitted work.

Ethical committee approval

This study received approval from the Institutional Review Board of the University of Texas at Austin. This study has been performed in accordance with the ethical standards in the 1964 Declaration of Helsinki. This study has been carried out in accordance with relevant regulations of the US Health Insurance Portability and Accountability Act (HIPAA).

Statement of location

This study was performed at The Dell Medical School – The University of Texas.

Declaration of competing interest

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Appendix 1. Bivariate analysis of factors associated with PROMIS PF

Variables	PROMIS PF	P value
Age (r)	−0.17	0.035
Sex		
Women	43 ± 9.5	0.064
Men	46 ± 10	
BMI (r)	−0.19	0.022
Race/Ethnicity		
White	45 ± 9.7	0.524
Non-White	44 ± 10	
Marital status		
Married	46 ± 9.8	0.031
Single	45 ± 11	
Separated/Divorced/Widowed	41 ± 8.4	
Insurance		
Private	47 ± 9.8	0.005
Medicare	41 ± 8.1	
Other	41 ± 10	
None	44 ± 8.7	
Trauma		
No	46 ± 10	0.091
Yes	43 ± 9.4	
Smoker		
No	45 ± 10	0.267
Yes	41 ± 7.6	
Comorbidities		
Diabetes		
No	45 ± 9.7	0.001
Yes	37 ± 8.6	
Musculoskeletal disease		
No	46 ± 9.8	0.013
Yes	40 ± 9.3	
Cardiovascular disease		
No	45 ± 9.9	0.047
Yes	41 ± 9.4	
Pulmonary		
No	45 ± 9.8	0.092
Yes	33 ± 5.1	
Other		
No	45 ± 9.7	0.083
Yes	42 ± 10	
ADI (r)		
State specific	−0.16	0.062
National	−0.19	0.024
Place in community (r)	0.28	< 0.001
Place in the USA (r)	0.25	0.002
Highest education grade completed		

High school or less (grade 1–12)	42 ± 11	0.021
(Some) College (grade 13–16)	44 ± 9.1	
(Some) Graduate or more (grade 17–20+)	48 ± 9.8	
Highest degree earned		
High school or equivalency (GED) or less	42 ± 9.6	0.078
Associate degree (junior college)	44 ± 9.7	
Bachelor's degree	45 ± 9.2	
Masters degree	48 ± 10	
Doctorate or Professional	49 ± 10	
Other	–	
Working status		
Working part-time/full-time	47 ± 9.6	< 0.001
Unemployed/Disabled	36 ± 7.5	
Keeping house/Student/Retired	43 ± 9.0	
Variables	PROMIS PF	P value
Personal income last 12 months		
Less than \$15,999	40 ± 9.6	0.022
\$16,000 - \$34,999	44 ± 10	
\$35,000 - \$49,999	44 ± 9.7	
\$50,000 - \$74,999	46 ± 11	
\$75,000 and greater	47 ± 8.9	
People in household		
One	41 ± 7.7	0.003
Two	45 ± 9.4	
Three	41 ± 9.3	
Four	48 ± 10	
Five or more	50 ± 12	
Adults in household		
One	42 ± 8.0	0.008
Two	46 ± 9.8	
Three	40 ± 9.5	
Four or more	49 ± 14	
Children in household		
None	44 ± 9.8	0.006
One	40 ± 8.0	
Two	48 ± 8.9	
Three or more	51 ± 11	
People in household with income		
None	40 ± 8.9	0.030
One	43 ± 9.0	
Two	47 ± 9.7	
Three or more	44 ± 14	
Home		
Owned	45 ± 9.6	0.245
Rented	44 ± 9.8	
Other	40 ± 12	
Total combined family income		
Less than \$15,999	37 ± 11	< 0.001
\$16,000 - \$34,999	43 ± 7.3	
\$35,000 - \$49,999	43 ± 11	
\$50,000 - \$74,999	39 ± 5.4	
\$75,000 and greater	48 ± 9.5	
Amount of time able to live at current address and standard of living when all sources of family income are lost.		
Less than 1 month	39 ± 9.6	0.056
1–2 months	48 ± 7.2	
3–6 months	45 ± 9.4	
7–12 months	45 ± 7.1	
More than 1 year	45 ± 11	
Financial assets		
Less than \$4999	40 ± 9.6	0.038
\$5000 - \$19,999	43 ± 8.6	
\$20,000 - \$99,999	45 ± 11	
\$100,000 - \$499,999	47 ± 8.6	
\$500,000 and greater	46 ± 9.5	
Net worth		
Less than \$4999	42 ± 9.3	0.023
\$5000 - \$19,999	49 ± 9.7	
\$20,000 - \$99,999	44 ± 11	
\$100,000 - \$499,999	47 ± 8.6	
\$500,000 and greater	47 ± 9.6	

Bold indicates statistically significant difference; Pearson correlation indicated by (*r*); Continuous variables as mean ± standard deviation; PROMIS PF = Patient-Reported Outcomes Measurement Information System Physical Function; BMI = Body Mass Index (kg/m²); ADI = Area Deprivation Index.

Bold indicates statistically significant difference; Continuous variables as mean ± standard deviation; PROMIS PF = Patient-Reported Outcomes Measurement Information System Physical Function; Financial assets = checking and savings accounts, and any stocks and bonds; Net worth = Financial assets minus any debt (credit card debt, unpaid loans including car loans, home mortgage).

Appendix 2. Bivariate analyses of socioeconomic variables

Variables	ADI state specific (r)	ADI national	Insurance status	Highest grade completed	Highest degree earned	Working status	Personal income	People in household with income	Home	Family income	Sources	Financial assets	Net worth
ADI state specific	x												
ADI national	0.962 (r) P < 0.001	x											
Insurance status	P < 0.001		x										
Highest grade completed	P = 0.002	P = 0.003	P < 0.001	x									
Highest degree earned	P < 0.001	P < 0.001	P < 0.001	P < 0.001	x								
Working status	P = 0.134	P = 0.182	P < 0.001	P < 0.001	P = 0.001	x							
Personal income	P < 0.001	P < 0.001	P = 0.003	P < 0.001	P = 0.001	P < 0.001	x						
People in household with income	P = 0.075	P = 0.049	P = 0.255	P = 0.034	P = 0.520	P = 0.015	P = 0.003	x					
Home	P = 0.015	P = 0.087	P = 0.063	P = 0.046	P = 0.056	P = 0.023	P = 0.017	P = 0.165	x				
Family income	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P = 0.001	P < 0.001	P < 0.001	P = 0.011	P = 0.004	x			
Sources	P = 0.058	P = 0.047	P = 0.095	P = 0.024	P = 0.001	P = 0.370	P = 0.006	P = 0.024	P < 0.001	P < 0.001	x		
Financial assets	P < 0.001	P < 0.001	P = 0.003	P = 0.027	P = 0.048	P = 0.352	P < 0.001	P = 0.178	P < 0.001	P < 0.001	P < 0.001	x	
Net worth	3.0 ± 2.4 P = 0.038	38 ± 26 P = 0.009	P = 0.050	P = 0.015	P = 0.028	P = 0.576	P < 0.001	P = 0.302	P = 0.047	P < 0.001	P < 0.001	P < 0.001	x

Bold indicates statistically significant difference; Pearson correlation indicated by (r); Categorical variables by Fisher's exact or Chi-square tests; ADI = Area Deprivation Index; Sources = amount of time able to live at current address and standard of living when all sources of family income are lost; Financial assets = checking and savings accounts, and any stocks and bonds; Net worth = Financial assets minus any debt (credit card debt, unpaid loans including car loans, home mortgage).

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