

The Cumulative Burden of Social Risk Factors and 10-Year Change in Quality of Life

Ro-Jay Reid, MD,^{1,*}  Monika Safford, MD,¹ W. Marcus Lambert, PhD, MSc,² Joanna Bryan, MPH,¹ Laura C. Pinheiro, PhD, MPH,¹ Madeline R. Sterling, MD, MPH, MS,¹  C. Barrett Bowling, MD, MSPH,³ Emily B. Levitan, ScD,⁴  Samprit Banerjee, PhD, M.Stat.,⁵ Raegan Durant, MD, MPH,⁶ Michael Kim,¹  Jennifer D. Lau, MPH,¹ and Parag Goyal, MD, MSc¹ 

¹Department of Medicine, Weill Cornell Medicine, New York, New York, USA.

²Department of Epidemiology and Biostatistics, SUNY Downstate Health Sciences University, Brooklyn, New York, USA.

³Department of Medicine, Durham Veterans Affairs Geriatric Research Education and Clinical Center, Durham Veterans Affairs Health Care System (VAHCS), Duke University, Durham, North Carolina, USA.

⁴Department of Epidemiology, University of Alabama at Birmingham, Birmingham, Alabama, USA.

⁵Department of Population Health Sciences, Weill Cornell Medicine, New York, New York, USA.

⁶Division of Preventive Medicine, University of Alabama at Birmingham, Birmingham, Alabama, USA.

*Address correspondence to: Ro-Jay Reid, MD. E-mail: ror2032@med.cornell.edu

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Abstract

Background: Social risk factors are linked to adverse health outcomes, but their total impact on long-term quality of life is obscure. We hypothesized that a higher burden of social risk factors is associated with greater decline in quality of life over 10 years.

Methods: We examined associations between social risk factors count and decline >5 points in (i) physical component summary, and (ii) mental component summary scores from the Short Form-12 among Black and White participants in the Reasons for Geographic and Racial Differences in Stroke study ($n = 14\,401$).

Results: For physical component summary, White participants with 1 social risk factor had relative risk (RR) for decline of 1.14 [95% confidence intervals (CI): 1.07–1.12]. Those with ≥ 2 social risk factors had RR of 1.26 [95% CI: 1.17–1.35], after adjusting for baseline demographics, health behaviors, medical conditions, medications, and physiological variables. Black participants with 1 social risk factor had RR of 1.03 [95% CI: 0.93–1.15]. Those with ≥ 2 social risk factors had RR of 1.24 [95% CI: 1.13–1.36]. For mental component summary, White participants with 1 social risk factor had RR for decline of 1.19 [95% CI: 1.04–1.37]. Those with ≥ 2 social risk factors had RR of 1.47 [95% CI: 1.28–1.68]. Black participants with 1 social risk factor had RR of 1.18 [95% CI: 0.96–1.45]. Those with ≥ 2 social risk factors had RR of 1.38 [95% CI: 1.14–1.66].

Conclusions: More social risk factors increased the risk of decline of quality of life for Black and White individuals, especially impacting mental health.

Keywords: 12-Item Short Form 12 (SF-12), Mental component summary (MCS) scores, Physical component summary (PCS) scores

Although life expectancy in the United States has increased significantly over the past decade (1), these additional years of life do not necessarily equate to a better quality of life (QoL) (2). A study conducted over the period from 1960 to 2019 demonstrated that the number of years spent in poor or moderate health remained unchanged despite an increase in life expectancy (3). Furthermore, it has been shown that longer life expectancy often means more years affected by disease and low physical functioning (4). These findings underscore the need to identify factors associated with worsening QoL.

Several studies have demonstrated an association between individual social determinants of health and QoL (5,6). These determinants, which can be either beneficial or deleterious to health, are defined by the World Health Organization as “the conditions in which people are born, grow, live, work,

and age,” ultimately influencing health outcomes (7). Social risk factors (SRF) denote adverse social determinants of health such as low income or low education level that are correlated with deteriorating health (8). For instance, in Hennepin County, adults with a household income below 200% of the federal poverty level were 2.3 times more likely to report physical limitations and poorer health compared to older adults with higher income levels. Similarly, educational attainment has been associated with self-rated health among individuals aged 65 and older, with those having less than a high school education reporting poorer health compared to those with a high school diploma or higher (9,10). Previous research has examined the connection between particular SRF like low education or annual household income, and QoL (11–17). However, to our knowledge, no studies have

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thoroughly investigated the influence of multiple SRF, both at individual and community levels, on longitudinal changes in QoL. This gap in the literature is significant, especially considering the probable requirement for community-level interventions to sustain improvements in SRF. Nonetheless, we recognize the vital importance of addressing individual-level SRF to improve overall health outcomes.

To address this knowledge gap, our study sought to determine the cumulative effect of multiple SRF on changes in physical and mental health-related QoL, within the REasons for Geographic And Racial Differences in Stroke (REGARDS) cohort study. We hypothesized that a higher burden of SRF would be significantly associated with a decline in QoL over a 10-year period, for both White and Black participants. We stratified our sample by race, acknowledging it as a social construct. This decision reflected our awareness that SRF affect racial groups unequally due to historical systemic discrimination, affecting access to resources and healthcare (18,19). By identifying race as a stratifying variable, we aim to better understand how SRF intersect with racial dynamics and contribute to disparities in QoL.

Method

Data and Resource Availability

The REGARDS study follows formal data use agreements when sharing data with investigators. For inquiries regarding the process of requesting information and accessing data, please contact the REGARDS study at regardsadmin@uab.edu.

REGARDS Cohort and Study Sample

The REasons for Geographic And Racial Differences in Stroke (REGARDS) study is a prospective, observational cohort that has a geographically diverse composition. Originally, the study aimed to investigate the reasons behind regional and racial disparities in stroke mortality. Detailed information about the study can be found elsewhere (20–24). In summary, between 2003 and 2007, the study recruited 30 239 community-dwelling adults aged 45 years and older who self-identified as Black or White race and not Hispanic/Latino residing in the contiguous United States. Upon enrollment, participants underwent a 45-minute computer-assisted telephone interview (CATI) to gather information on their medical history, health behaviors, and risk factors. Subsequent in-home visits were conducted to assess physiological parameters including height, weight, and blood pressure, as well as perform electrocardiography. Blood and urine samples were collected and sent to the study's central laboratory at the University of Vermont. Medications taken in the 2 weeks preceding the study visit were documented through a review of pill bottles. Over the course of the study, participants were contacted every 6 months via telephone to identify any potential study outcomes. Approximately 10 years later, between 2013 and 2016, participants underwent a follow-up CATI and in-home assessment. All participants in the REGARDS study provided written informed consent, and the study protocol was approved by the institutional review boards of all participating institutions (20–24).

Main Exposure

SRF similar to prior studies examining SRF in REGARDS (21–24), we used the Healthy People 2030 framework (25)

to identify and operationalize relevant SRF available in REGARDS at baseline. The domains of this framework are (1) economic stability, (2) education access and quality, (3) social and community context, (4) neighborhood and built environment, and (5) healthcare access and quality (24). Available SRF from REGARDS included:

- annual income <\$35 000 (economic stability);
- education less than high school level (education access and quality);
- receiving ≤ 1 visits from a friend or family member in the past month (social and community context);
- having no one to care for them should they become ill (social and community context);
- marital status (social and community context);
- residing in a zip code with >25% of residents living below the federal poverty line (neighborhood and built environment);
- residing in a rural residence as defined by the US Department of Agriculture Rural Urban Commuting Area codes 9 (small towns with low commuting to urban areas) and 10 (rural areas where commuting is local or to other rural areas) (26) (neighborhood and built environment);
- living in a county designated as a complete/partial Health Professional Shortage Area (HPSA) (neighborhood and built environment);
- living in a state with poor public health infrastructure (assessed using data from the America's Health Ranking, which ranked states from 1993 to 2002 based on their contribution to lifestyle, access to care, and disability; states that fell into the bottom 20th percentile for their ranking for ≥ 8 years) (27) (neighborhood and built environment);
- having no health insurance (healthcare access and quality).

We used these 10 SRF for the purposes of SRF count in this study.

Outcomes: Decline in the Physical and Mental Domains of Quality of Life

Our study focused on 2 primary QoL outcomes: declines in physical and mental health-related QoL. We measured these 2 outcomes using the 12-Item Short Form Health Survey (SF-12). The SF-12 is a generic, psychometrically validated instrument with 12 items that capture both physical and mental well-being (28). The SF-12 has 2 subscales: the Physical Component Summary (PCS) score and the Mental Component Summary (MCS) score. Each subscale ranges from 0 to 100 with higher scores indicating better QoL. The PCS and MCS are normed to the U.S. general population with a mean of 50 and a standard deviation (*SD*) of 10 (28). As part of the REGARDS study, participants completed the SF-12 questionnaire at baseline and again at the 10-year follow-up. We operationalized declines in PCS and MCS by calculating the differences in PCS and MCS scores between baseline and follow-up. There is no consensus on defining a meaningful numerical value for change in PCS and MCS over a 10-year period. As such, we used Cohen's definition of a medium effect size (0.5 of an *SD* or 5 points for the PCS and MCS). Prior studies have also used Cohen's suggestion to define a meaningful value in QoL instruments (29).

Covariates

In our study, we included several covariates based on the existing literature to isolate the associations between SRF and QoL declines (20–24). These covariates encompassed baseline demographics, baseline PCS and MCS, health behaviors, medical conditions, medication use, and physiological variables. Demographic factors considered were age, gender, and region (categorized as stroke belt, stroke buckle, and nonbelt). Health behaviors included self-reported current cigarette smoking, alcohol use (based on sex-specific National Institute on Drug Abuse guidelines, with risky drinking defined as consuming ≥ 7 drinks weekly for women and ≥ 14 drinks weekly for men) (30), and physical activity (categorized as enough activity to work up a sweat ≥ 4 days per week vs others). Medical condition covariates encompassed a history of cardiovascular disease (including myocardial infarction, coronary artery bypass graft, angioplasty, and stroke), hypertension (self-reported diagnosis, use of antihypertensive medication, or blood pressure measurements $\geq 140/90$ mm Hg), high cholesterol (use of lipid-lowering medications, LDL cholesterol >130 mg/dL, or self-report of diagnosis), diabetes (use of diabetes medications or insulin, fasting blood glucose >126 mg/dL, or nonfasting glucose >200 mg/dL), chronic kidney disease (estimated glomerular filtration rate (eGFR) <60 mL/min/1.73 m² using the Chronic Kidney Disease-Epidemiology equation) (31), stroke (self-reported), and history of heart disease (self-reported myocardial infarction, coronary artery bypass graft, angioplasty, or evidence of myocardial infarction on electrocardiogram). Medication use covariates included self-reported current use of antihypertensive medications, insulin, and statins (obtained through medication inventory during in-home visits). Physiological variables considered were body mass index, systolic blood pressure, diastolic blood pressure, and cholesterol levels.

Statistical Analysis

To ensure that the same SRF were selected for both White and Black individuals, we preselected SRF in the overall sample by examining age-adjusted associations between each SDOH and a decline of >5 points in PCS and MCS, separately. SDOH with a relative risk (RR) > 1.00 were termed SRF and retained to develop a count of SRF. This approach of preselecting SRF in the overall sample improved the statistical robustness of the analyses and ensured standardization, making it easier to compare results across different racial groups. It also reduced sampling bias by minimizing the risk of introducing confounding variables that were only significant in one group, thus reducing bias arising from the unique characteristics of individual racial groups. Afterward, we stratified our sample by race (Black vs White) and conducted separate analyses for each race group. To assess potential collinearity among the ten SRF variables, we calculated Pearson correlations. We used Poisson models with robust standard errors to estimate the RR ratios and 95% confidence intervals (CI). There was a small number of participants with ≥ 3 SRF for the outcome of PCS decline among Blacks. Therefore, for consistency, all SRF counts were categorized as 0, 1, and ≥ 2 . We described the distribution of sample characteristics across these 3 SRF groups. Poisson models with robust standard errors were also used to estimate the association between SRF count and PCS (or MCS). To assess the influence of covariates on the association between the SRF count and PCS (or MCS) declines, we added covariates sequentially. First, we adjusted

for age, sex, and region. Next, we adjusted for baseline PCS (or MCS). Subsequently, we added health behaviors, medical conditions/medication use, and the physiological covariates previously mentioned. We calculated p values to test for statistical significance between the SRF count groups and calculated p for trend (p_{trend}) to assess the overall trend for the SRF count variable. To handle missing data on SRF and covariates, we used multiple imputation with chained equations. We generated 20 imputed data sets and applied Rubin's rules to combine the model estimates (32). All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC) and Stata 14 (StataCorp LP, College Station, TX) software.

To assess the robustness of our findings, we conducted several sensitivity analyses. First, we repeated the analysis using Cohen's small effective size (>2 points) as a threshold for decline, which has also been done in previous studies (33). To account for competing risks (ie, death before 10 years), we examined a composite QoL outcome that combined a decline of >5 points with death. Finally, we used inverse-probability weighting to address potential selection bias from the exclusion of participants who (1) declined to participate in the follow-up exam, (2) were unreachable for telephone follow-up for 2 consecutive years, or (3) died before the follow-up.

Results

Study Population

Of the 30 239 participants enrolled in the REGARDS study, 14 401 were included in the analyses (Supplementary Figure 1). There were 5 935 participants who died prior to the follow-up visit and were therefore excluded from the main analysis—these participants were older than those who survived and had more comorbidities (Supplementary Table 1). In our sample, the median time between baseline and follow-up was 9.5 years (IQR 8.7–9.9). At baseline, the mean age (SD) was 62.9 (8.3) years and 56.2% were female. A total of 5 316 (36.9%) participants self-identified as Black. Approximately 36% of the sample had a decline in PCS. The mean PCS change over ~ 10 years was -3.17 with an SD of 10.01. Approximately, 17% of the sample had a decline in MCS. The mean MCS change over ~ 10 years was 0.71 with an SD of 8.69. For more information about baseline characteristics, please refer to Table 1.

Most of the SRF had weak correlations with each other (as shown in Supplementary Tables 2 and 3).

Preselection of SRF Separately by PCS and MCS

Physical component summary

Of the 10 SDOH examined, only 5 were found to be significant SRF (SDOH with adverse effect with RR > 1.00) and were retained for the analysis investigating the relationship between the cumulative count of SRF and the decline in PCS among Black and White participants. These 5 SRF were (i) annual income $< \$35 000$, (ii) education $<$ high school level, (iii) having no one to care for them if they become ill, (iv) not being married, and (v) having no health insurance. The remaining 5 SDOH with an RR ≤ 1.00 were not considered risk factors in regard to PCS scores for Black and White individuals. See Table 2 for more details.

Mental component summary

Of the 10 SDOH examined, only 9 were found to be significant SRF and were retained for further analysis investigating

Table 1. Characteristics of Participants Categorized by Race

Characteristics ^a	Overall Sample [*]	White Participants [*]	Black Participants [*]
N (%)	14 401	9 085 (63.1)	5 316 (36.9)
Number with decline in PCS, <i>n</i> (%)	5 186 (36.0)	1 883 (35.4)	3 303 (36.4)
Number with decline in MCS, <i>n</i> (%)	2 454 (17.0)	1 023 (19.2)	1 431 (15.8)
SRF considered for count, <i>n</i> (%)			
Income <\$35 000	4 944 (38.2)	2 531 (31.2)	2 413 (50.2)
Education < high school	1 053 (7.3)	391 (4.3)	662 (12.5)
Social isolation from friends and family within the past month	1 522 (10.7)	911 (10.1)	611 (11.7)
Social isolation—no one to provide care if ill	1 703 (12.5)	1 047 (12.2)	656 (13.2)
Not married	5 134 (35.7)	2 422 (26.7)	2 712 (51.0)
No health insurance	852 (5.9)	351 (3.9)	501 (9.4)
Living in a state with poor public health infrastructure	4 763 (33.1)	3 191 (35.1)	1 572 (29.6)
Residence in complete or partial HPSA	5 930 (41.2)	3 372 (37.1)	2 558 (48.1)
Rural residence	367 (2.8)	316 (3.9)	51 (1.0)
>25% of residents living below the Federal poverty line	2 445 (17.3)	819 (9.2)	1 626 (30.8)
PCS SRF count, <i>n</i> (%)			
SRF 0	5 393 (42.4)	4 108 (51.6)	1 285 (26.9)
SRF 1	3 184 (25.0)	1 916 (24.1)	1 268 (26.5)
SRF ≥ 2	4 157 (32.6)	1 931 (24.3)	2 226 (46.6)
MCS SRF count, <i>n</i> (%)			
SRF 0	2 610 (21.0)	1 984 (26.1)	626 (13.0)
SRF 1	3 175 (25.5)	2 187 (28.7)	988 (20.5)
SRF ≥ 2	6 648 (53.5)	3 444 (45.2)	3 204 (66.5)
Baseline characteristics, <i>n</i> (%)			
Age, mean (<i>SD</i>)	62.86 (8.34)	63.26 (8.40)	62.17 (8.18)
Female	8 094 (56.2)	4 659 (51.3)	3 435 (64.6)
Hypertension	8 354 (58.0)	4 556 (50.1)	3 798 (71.4)
Hyperlipidemia	9 283 (64.5)	5 892 (64.9)	3 391 (63.8)
Diabetes	2 343 (16.8)	1 046 (11.9)	1 297 (25.3)
eGFR < 60 mL/min/1.73 m ²	937 (6.7)	560 (6.3)	377 (7.4)
History of heart disease (MI, CABG, angioplasty)	1 863 (13.2)	1 272 (14.2)	591 (11.3)
Antihypertensive use	6 749 (48.8)	3 513 (40.4)	3 236 (63.2)
Statin use	4 348 (30.3)	2 870 (31.6)	1 478 (27.9)
Insulin use	516 (3.8)	190 (2.2)	326 (6.5)
Current smoking	1 614 (11.2)	878 (9.7)	736 (13.9)
Heavy alcohol use	616 (4.3)	490 (5.5)	126 (2.4)
Adequate exercise	4 408 (30.9)	2 987 (33.2)	1 421 (27.0)
High Mediterranean diet adherence	1 298 (11.7)	846 (11.0)	452 (13.3)
Body Mass Index—kg/m ² , mean (<i>SD</i>)	29.27 (±5.98)	28.24 (±5.39)	31.02 (6.51)
Systolic blood pressure (mmHg), mean (<i>SD</i>)	125.59 (±15.67)	123.75 (±15.15)	128.72 (±16.05)
Diastolic blood pressure (mmHg), mean (<i>SD</i>)	76.38 (±9.26)	75.30 (±8.95)	78.21 (±9.48)
Total cholesterol (mg/dL), mean (<i>SD</i>)	192.87 (±38.81)	192.49 (±38.16)	193.54 (±39.90)
PCS, mean (<i>SD</i>)	48.17 (±9.69)	49.07 (±9.27)	46.63 (±10.17)
MCS, mean (<i>SD</i>)	54.53 (±7.76)	54.77 (±7.39)	54.12 (±8.34)

Notes: CABG = coronary artery bypass graft; eGFR = estimated glomerular filtration rate; HPSA = Health Professional Shortage Area; MCS = mental component summary; MI = myocardial infarction; PCS = physical component summary; SRF = social risk factors. Public health infrastructure vulnerability includes 9 states whose ranking had been in the bottom 20% for poor health infrastructure for ≥80% of the time between 1993 and 2002. The time reflects the 10 years preceding when Reasons for Geographic and Racial Differences in Strokes study baseline data collection started in 2003.

Social isolation from friends/family, defined as those who have 0 or 1 friend/family that they have seen in the past month.

Rural residence defined as living in an isolated or small rural area. Based in Rural/Urban Commuting Area codes.

Heavy alcohol use defined as consuming ≥7 drinks weekly for women and ≥14 drinks weekly for men.

^aVariables with missing data include: income (*n* = 1 472), education (*n* = 2), social isolation from friends and family within the past month (*n* = 169), social isolation—no one to provide care if ill (*n* = 825), insurance (*n* = 8), living in state with poor public health infrastructure (*n* = 7), residence in complete or partial HPSA (*n* = 7), rural residence (*n* = 1 373), zip code level poverty (*n* = 232), diabetes (*n* = 468), eGFR (*n* = 485), history of heart disease (*n* = 247), history of stroke (*n* = 33), antihypertensive use (*n* = 572), statin use (*n* = 35), insulin use (*n* = 650), current smoking (*n* = 45), heavy alcohol use (*n* = 219), exercise (*n* = 151), body mass index (*n* = 79), Systolic blood pressure (*n* = 41), Diastolic blood pressure (*n* = 42), total cholesterol (*n* = 485), PCS SRF count (2 220), MCS SRF count (1 968).

the relationship between the cumulative count of SRF and the decline in MCS among Black and White participants. These 9 SRF were (i) annual income <\$35 000, (ii) education < high school level, (iii) social isolation from friends and family within the past month, (iv) having no one to care for them if they become ill, (v) not being married, (vi) having no health insurance, (vii) living in a state with poor public health infrastructure, (viii) living in a rural area, and (ix) residing in a zip code where >25% of residents live below the federal poverty line. The retaining one, “residence in a complete or partial HPSA” was not considered to be a risk factor in regard to MCS score for Black and White individuals. See [Table 2](#) for more details.

SRF with the greatest decline in PCS, stratified by race

Among White participants as shown in [Table 3](#), the baseline SRF that exhibited the strongest association with a PCS decline >5 points over 10 years was lack of health insurance (RR: 1.27, 95% CI: 1.11–1.46).

Among Black participants as shown in [Table 3](#), the baseline SRF that exhibited the strongest association with a PCS decline > 5 points over 10 years was having an annual household income of less than \$35 000 (RR: 1.11, 95% CI: 1.03–1.20).

SRF with the greatest decline in MCS, stratified by race

Among White participants as shown in [Table 3](#), the baseline SRF that exhibited the strongest association with MCS decline >5 points over 10 years was having less than a high school diploma (RR: 1.60, 95% CI: 1.34–1.91).

Among Black participants as shown in [Table 3](#), the baseline SRF that exhibited the strongest association with an MCS decline >5 points over 10 years was having less than a high school diploma (RR: 1.35, 95% CI: 1.17–1.56).

Baseline Characteristics by SRF Count, as well as by PCS and MCS Scores

Physical component summary

At baseline, 24.3% of White participants had ≥ 2 SRF compared to 46.6% of Black participants who had ≥ 2 SRF (see [Supplementary Table 4](#) for more details). In both Black and White participants with ≥ 2 SRF for PCS scores, a higher proportion had an annual income below \$35 000 and were unmarried compared to those with 0 SRF. Additionally, they were more likely to be older, female, and have certain comorbid conditions such as hypertension, diabetes, and an eGFR below 60 mL/min/1.73 m² compared to those with 0 SRF.

Mental component summary

At baseline, 45.2% of White participants had ≥ 2 SRF compared to 66.5% of Black participants who had ≥ 2 SRF (see [Supplementary Table 5](#) for more details). Similarly to PCS, both Black and White participants with ≥ 2 SRF for MCS scores, a higher proportion had an annual income below \$35 000 and were unmarried compared to those with 0 SRF. Additionally, they were more likely to be older, female, and have certain comorbid conditions such as hypertension, diabetes, and an eGFR below 60 mL/min/1.73 m² compared to those with 0 SRF.

Declines Over Time

Physical component summary

Among White participants, 31.7% of those with 0 SRF experienced a >5-point decline in PCS over ~10 years. Of those with

Table 2. Preselection of Age-Adjusted Social Risk Factors with RR > 1.00 and Their Association with a 5-Point Decline in Physical Component Summary (PCS) and Mental Component Summary (MCS) Scores on the 12-Item Short Form Survey

SRF	Greater Than 5 Points Decline in PCS	Greater Than 5 Points Decline in MCS
	N = 14 401	N = 14 401
	RR (95% CI)	RR (95% CI)
Income <\$35 000	1.12 (1.07–1.18)	1.42 (1.32–1.54)
Education < high school	1.07 (0.99–1.15)	1.53 (1.37–1.70)
Social isolation from friends and family within the past month	0.97 (0.90–1.04)	1.17 (1.05–1.30)
Social isolation—no one to provide care if ill	1.09 (1.02–1.16)	1.19 (1.07–1.32)
Not married	1.12 (1.07–1.17)	1.16 (1.07–1.25)
No health insurance	1.11 (1.00–1.22)	1.21 (1.05–1.41)
Living in a state with poor public health infrastructure	1.00 (0.96–1.05)	1.08 (1.00–1.16)
Residence in complete or partial HPSA	0.96 (0.92–1.00)	0.99 (0.92–1.06)
Rural residence	0.99 (0.86–1.14)	1.07 (0.84–1.36)
> 25% of residents living below the Federal poverty line	1.00 (0.95–1.06)	1.18 (1.08–1.29)

Notes: CI = confidence interval; HPSA = Health Professional Shortage Area; RR = relative risk.

The SRFs retained for the SRF count were those with an RR > 1.00 for both PCS and MCS.

For PCS, these included 5 SRF. They were: annual income <\$35 000, education < high school level, having no one to care for them if they become ill, not being married and having no health insurance.

For MCS, these SRF included all except residence in complete or partial HPSA.

1 SRF, 38.2% experienced a decline while 43.2% of those with >2 SRF experienced a decline ([Supplementary Table 4](#)). Overall, 35.4% of White participants had a >5-point decline in PCS. Each increase in the SRF count was associated with a greater risk of a decline for both the age-adjusted and fully adjusted models ([Table 4](#)). Compared to those with 0 SRF in the age-adjusted model, those with 1 SRF had an RR of 1.14 [95% CI: 1.07–1.22] while those with ≥ 2 SRF had an RR of 1.24 [95% CI: 1.16–1.32] with a *p* for trend of <.001. In the fully adjusted model, the associations were strengthened. Compared to those with 0 SRF count in the fully adjusted model, those with 1 SRF had an RR of 1.14 [95% CI: 1.07–1.22] while those ≥ 2 SRF had an RR of 1.26 [95% CI: 1.17–1.35] with a *p* for trend of <.001.

Among Black participants, 32.0% of those with 0 SRF experienced a >5-point decline over ~10 years. Of those with 1 SRF, 33.4% experienced a decline while 38.6% of those with >2 SRF experienced a decline ([Supplementary Table 4](#)). Overall, 36.4% of Black participants had a >5-point decline in PCS. For Black participants, both age-adjusted and fully adjusted models revealed a greater risk of decline with each increase in the SRF count ([Table 4](#)). Compared to those with 0 SRF in the age-adjusted model, those with 1 SRF had an RR of 1.08 [95% CI: 0.96–1.21] while those with ≥ 2 SRF had RR 1.18 [95% CI: 1.07–1.30] with *p* for trend of 0.001. In

Table 3. Age-Adjusted Individual Relative Risks for 10 Social Risk Factors (SRF) and a 5-Point Decline in Physical Component Summary (PCS) and Mental Component Summary (MCS) Scores of the 12-Item Short Form Survey, Stratified by Race

SRF	Greater Than 5 Points Decline in PCS		Greater Than 5 Points Decline in MCS	
	White Participants N = 9 085	Black Participants N = 5 316	White Participants N = 9 085	Black Participants N = 5 316
	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Income <\$35 000	1.14 (1.07–1.21)	1.11 (1.03–1.20)	1.49 (1.34–1.65)	1.24 (1.10–1.39)
Education < high school	1.13 (1.01–1.27)	1.05 (0.95–1.16)	1.60 (1.34–1.91)	1.35 (1.17–1.56)
Social isolation from friends and family within the past month	1.01 (0.92–1.11)	0.90 (0.80–1.02)	1.20 (1.04–1.39)	1.11 (0.94–1.31)
Social isolation—no one to provide care if ill	1.09 (1.01–1.18)	1.08 (0.97–1.20)	1.28 (1.12–1.46)	1.06 (0.90–1.25)
Not married	1.17 (1.10–1.24)	1.06 (0.99–1.14)	1.13 (1.01–1.25)	1.07 (0.96–1.20)
No health insurance	1.27 (1.11–1.46)	0.97 (0.85–1.11)	1.35 (1.09–1.69)	1.05 (0.86–1.28)
Living in a state with poor public health infrastructure	1.00 (0.95–1.06)	0.99 (0.92–1.08)	1.08 (0.98–1.19)	1.11 (0.99–1.25)
Residence in complete or partial HPSA	0.95 (0.90–1.01)	0.98 (0.91–1.05)	0.94 (0.85–1.04)	0.98 (0.88–1.10)
Rural residence	1.07 (0.93–1.23)	0.45 (0.23–0.89)	1.15 (0.88–1.50)	1.02 (0.58–1.80)
> 25% of residents living below the Federal poverty line	0.99 (0.90–1.09)	1.02 (0.95–1.11)	1.20 (1.03–1.39)	1.04 (0.92–1.17)

Notes: CI = confidence interval; HPSA = Health Professional Shortage Area; RR = relative risk.

The SRFs retained for the SRF count were those with an RR > 1.00 for both PCS and MCS.

For PCS, these SRF included: annual income <\$35 000, education < high school level, having no one to care for them if they become ill, not being married and having no health insurance.

For MCS, these SRF included all except residence in complete or partial HPSA.

Table 4. Relative Risk Ratios for the Association Between the Social Risk Factor (SRF) Count and > 5-Point Decline in Physical Component Summary (PCS) score

SRF count	White Participants* N = 9 085				Black Participants* N = 5 316			
	Age-adjusted		Fully adjusted		Age-adjusted		Fully adjusted	
	RR (95% CI)	p Value	RR (95% CI)	p Value	RR (95% CI)	p Value	RR (95% CI)	p Value
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	1.14 (1.07–1.22)	<0.001	1.14 (1.07–1.22)	<0.001	1.01 (0.91–1.13)	0.798	1.03 (0.93–1.15)	0.578
≥2	1.24 (1.16–1.32)	<0.001	1.26 (1.17–1.35)	<0.001	1.14 (1.04–1.25)	0.005	1.24 (1.13–1.36)	<0.001

Notes: CI = confidence interval; RR = relative risk. Fully adjusted model includes: age, demographics, health behaviors, baseline medical conditions, medications, and physiologic measures.

*For White participants, the *p* value for trend was <0.001 in both age-adjusted and fully adjusted analyses. Conversely, for Black participants, the *p* value for trend was 0.003 in the age-adjusted analysis and <0.001 in the fully adjusted analysis.

the fully adjusted model, the associations were strengthened. Compared to those with 0 SRF in the fully adjusted model, those with 1 SRF had an RR of 1.07 [95% CI: 0.96–1.20] while those with ≥2 SRF had an RR of 1.27 [95% CI: 1.15–1.41] with a *p* for trend of <.001.

Mental component summary

Among White participants, 11.9% of those with 0 SRF experienced a >5-point decline in MCS over 10 years. Of those with 1 SRF, 14.5% experienced a decline while 18.9% of those with >2 SRF experienced a decline (Supplementary Table 5). Overall, 19.2% of White participants had a >5-point decline in MCS. Similar trends for both age-adjusted and fully adjusted models were observed with each SRF count and risk of >5-point decline in MCS among White participants (Table 5). Compared to those with 0 SRF in the age-adjusted model, those with 1 SRF had an RR of 1.21 [95% CI: 1.05–1.39] while those with ≥2 SRF had an RR of 1.49 [95% CI: 1.31–1.69] with a *p* for trend of <.001. In the fully adjusted model,

the associations were attenuated. Compared to those with 0 SRF count in the fully adjusted model, those with 1 SRF had an RR of 1.19 [95% CI: 1.04–1.37] while those ≥2 SRF had an RR of 1.47 [95% CI: 1.28–1.68] with a *p* for trend of <.001.

Among Black participants, 15.3% of those with 0 SRF experienced a >5-point decline over ~10 years. Of those with 1 SRF, 18.8% experienced a decline while 20.5% of those with >2 SRF experienced a decline (Supplementary Table 5). Overall, 15.8% of Black participants had a >5-point decline in MCS. A similar trend for both age-adjusted and fully adjusted models was observed with each SRF count and risk of >5-point decline in MCS among Black participants (Table 5). Compared to those with 0 SRF in the age-adjusted model, those with 1 SRF had an RR of 1.19 [95% CI: 0.97–1.47] while those with ≥2 SRF had an RR of 1.32 [95% CI: 1.10–1.59] with a *p* for trend of .002. Compared to those with 0 SRF count in the fully adjusted model, those with 1 SRF had an RR of 1.18 [95% CI: 0.96–1.45] while those ≥2 SRF

Table 5. Relative Risk Ratios for the Association Between Social Risk Factor (SRF) Count and > 5-Point in Mental Component Summary (MCS) Score

SRF count	White participants* N = 9 085				Black participants* N = 5 316			
	Age-adjusted		Fully adjusted		Age-adjusted		Fully adjusted	
	RR (95% CI)	<i>p</i> Value	RR (95% CI)	<i>p</i> Value	RR (95% CI)	<i>p</i> Value	RR (95% CI)	<i>p</i> Value
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	1.21 (1.05–1.39)	0.008	1.19 (1.04–1.37)	0.014	1.19 (0.97–1.47)	0.102	1.18 (0.96–1.45)	0.125
≥2	1.49 (1.31–1.69)	<0.001	1.47 (1.28–1.68)	<0.001	1.32 (1.10–1.59)	0.003	1.38 (1.14–1.66)	0.001

Note: CI = confidence interval; RR = relative risk. Fully adjusted model includes: age, demographics, health behaviors, baseline medical conditions, medications, and physiologic measures.

*For White participants, the *p* value for trend was <0.001 in both age-adjusted and fully adjusted analyses. Conversely, for Black participants, the *p* value for trend was 0.002 in the age-adjusted analysis and <0.001 in the fully adjusted analysis.

had an RR of 1.38 [95% CI: 1.14–1.66] with a *p* for trend of <.001. See [Supplementary Tables 6 and 7](#) for additional information on the impact of various covariates on decline in PCS and MCS.

Sensitivity Analyses

The sensitivity analyses assessing a decline of >2 points in PCS and MCS over ~10 years revealed similar graded associations with each additional SRF for both Black and White participants, although statistical significance was only observed among White participants (see [Supplementary Tables 8 and 9](#)). When we examined those with a decline >5 points for PCS, MCS, and those who died during the study period, similar graded associations with statistical significance for both Black and White participants were also observed (see [Supplementary Tables 10 and 11](#)). Inverse-probability weighted analyses to account for death and withdrawal did not vary substantially from the main analysis (see [Supplementary Tables 12 and 13](#)).

Discussion

This analysis of a biracial geographically diverse cohort yielded 4 key findings. Firstly, we found that for both Black and White participants, a higher number of SRF was associated with a stepwise decline in both the physical and mental domains of QoL over ~10-year period. Secondly, our findings suggested that the observed associations between SRF and decline in mental QoL tended to be more pronounced than for physical QoL. Thirdly, our findings also suggest that limited educational attainment may be the strongest risk factor for a decline in mental well-being for both Black and White participants. Lastly, lack of health insurance appeared to be the strongest risk factor for a decline in physical well-being among White participants, while income below \$35 000 appeared to be the strongest risk factor for a decline in physical well-being among Black participants.

Previous studies have demonstrated the importance of SRF for multiple outcomes including hospital readmission, patient experience, timeliness of care, efficient use of medical imaging, and mortality across multiple settings ([21,23,24,34](#)). Our findings further contribute to this body of knowledge by highlighting the influence of multiple SRF on declines in QoL over a 10-year timeframe. The reasons behind these associations are complex and likely encompass multiple factors including the built environment, access to health resources, and social service connections ([35](#)). The onset of new medical conditions

also likely explains our observation. Individuals with a high burden of SRF have a higher incidence of medical conditions like myocardial infarction, stroke, and heart failure ([20–24](#)), which when present, have well-known negative effects on QoL ([6,11,12,28,33](#)). Future research focusing on key mediators of our observations could provide unique insights into potential opportunities to prevent or mitigate declines in QoL.

Our findings suggested the possibility that SRF has a stronger impact on mental health compared to physical health. Dealing with SRF can be stressful resulting in psychological fatigue, burnout, depression, occupational disability, and suicide ([36–38](#)). There may be additional biological mechanisms also underlying the effect of SRF on mental health. For example, allostatic load has been proposed as a mechanism linking SRF to negative health effects ([39](#)). Allostatic load refers to the cumulative physiological wear and tear caused by chronic stress on the body ([39](#)). Previous studies have shown that allostatic load can lead to dysregulation of hormones that affect the prefrontal cortex, resulting in depressive symptoms as well as difficulties with memory, attention, and decision-making ([40](#)). Taken together, our findings have implications on mental health screening. Currently, the United States Preventive Services Task Force recommends screening for depression ([41](#)), though uptake has historically been limited ([42](#)). Our findings highlight the importance of increasing mental health assessments, at the very least among those with higher burdens of SRF. Future work on increasing the implementation of mental health assessments is ongoing ([43](#)) and will likely be critical to improving the QoL of adults with SRF.

Among the 10 SRF studied, we found that limited education had most likely the largest RR for a significant association with decline in mental health in both Black and White participants. This finding further underscores the importance of education. Education equips individuals with more than just facts and education is important beyond just career selection. Education level is closely linked with essential skills and knowledge to effectively cope with stress and challenges in life. It can also encourage emotional intelligence and lead to healthy space which can normalize discussions around mental health and well-being ([44](#)). Hence, it is reasonable to comprehend the underlying reasons behind the association between limited education and the prevalence of numerous detrimental health outcomes, notably the significant decline in the mental domain of QoL, as evidenced by our recent findings. Our study thus further underscores the critical need to invest in the broader educational needs in our society as

a means of helping individuals preserve their mental QoL as they age.

It is unclear why the lack of health insurance emerged as the most likely significant factor associated with a decline in physical health among White participants, while low income was likely the most impactful factor for Black participants. These differences may be influenced by systemic factors such as racism and discrimination, which have woven themselves into familial safety nets/generational wealth and racial segregation, thus differentially affecting access to resources and opportunities across racial groups. For instance, Black families are more likely to have higher rates of unemployed family members and are more likely to be entrenched in familial structures where financial assistance predominantly flows in 1 direction, making them less likely to be homeowners and weakening the effectiveness of family safety resources that individuals can draw on to provide material help to family members, compared to Whites (45,46). This exacerbates the impact of low income on health outcomes.

Conversely, White individuals are more likely to experience economic stability compared to Blacks, thus lessening the impact of income on the decline of QoL between the 2 racial groups (47). Interestingly, even White individuals living in lower socioeconomic status are more likely to reside in areas of diverse range of socioeconomic levels, affording even the poorest White residents access to social safety nets and community resources that buffer against the effects of poverty (35,47). This may make health insurance a more critical determinant of their health, as opposed to income. Conversely, Blacks are more likely to reside in areas of concentrated poverty. Although income and health insurance may be viewed as similar constructs given that a lack of both may result in medical conditions that impact physical health (48,49), they were not collinear in this study, supporting their roles as independent and distinct factors that can impact outcomes.

Our study is not without unexpected findings. The unexpected lower risk estimates observed for Black participants compared to White participants should be interpreted with caution, as our study was not specifically designed to examine which race is more likely to have a lower QoL due to SRF, but rather to assess the impact of SRF on both racial groups. We speculate that the lower RRs among Black participants may be attributed to unmeasured SRF that were not included in our study. Future research should consider SRF factors such as redlining and mass incarceration, which are known to be significant factors in Black communities. This highlights the importance of developing SRF risk prediction tools that capture these differences between racial groups and enable a more comprehensive understanding of their impact on health outcomes.

Strengths and Limitations

Our study has several notable strengths. Firstly, we utilized a large and biracial cohort that includes oversampling of Black individuals. The high number of Black participants included in this study [$N = 5\,316$ (36.9%)] and geographic diversity substantially increases the generalizability of our findings. Additionally, our study examined 10 unique SRF (none of which were collinear), providing one of the most comprehensive studies of SRF and QoL to date. Our study also had some limitations. As with all observational studies, associations do not imply causation. For simplicity, SRF variables

were treated in a binary fashion (present or absent) for the purposes of this analysis, just as they have been done in prior studies in REGARDS (21–24) associations across continuous spectrum of each SRF may be worth exploring in future studies. In addition, we examined SRF ascertained at baseline, and thus could not account for changes in SRF over the course of the study—this could have led to misclassification bias. Although we captured 10 unique SRF, there are many other SRF that may be important including but not limited to as structural racism, police brutality, mass incarceration, and redlining. Also, the population norms for change in SF-12 over ~10-year period are not well established, and therefore the decision to choose a threshold of >5-point change to define decline in the mental and physical domains of QoL was empiric. However, when we changed the threshold to a >2-point decline, results were similar.

Another limitation is the including covariates like health behaviors, medical conditions, etc, potentially mediating between SRF and QoL and leading to overadjustment and underestimating the impact of SRF. We addressed this by stepwise adjustments, gradually adding variables to create fully adjusted models, though this might have underestimated SRF impact (see [Supplementary Tables 6–13](#)). Future studies should use mediation analysis to better consider covariates in the causal pathway.

Conclusion

In this large national biracial cohort, we found that the risk of decline in physical and mental domains of QoL increased in a graded fashion with each additional SRF for both Black and White individuals and that SRF was more strongly associated with declines in mental health compared to declines in physical health. These findings have important implications on the well-being of adults with a higher burden of SRF.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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Conflict of Interest

M.S. receives salary support from Amgen for investigator-initiated research. P.G. is supported by National Institute on Aging grants K76AG064428 and has received consulting fees from Sensorum Health, Agepha Pharma, Akros Pharma, Axon Therapies, and has received personal fees for medicolegal consulting and expert testimony related to heart failure. E.B.L. receives research funding (to UAB) from Amgen Inc and personal fees from the University of Pittsburgh for serving on a Data and Safety Monitoring Board. The other authors report no conflicts.

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Authors Contributions

The study was conceptualized by a collaborative effort involving R.-J.R., M.S., P.G., and W.M.L. J.B. was the lead statistician, while R.-J.R. was the primary author. The article saw revisions from M.S., P.G., W.M.L., J.B., L.C.P., M.R.S., C.B.B., E.B.L., S.B., R.D., M.K., and J.D.L. Data access and verification tasks were performed by R.-J.R. and J.B. Lastly, the corresponding author took on the responsibility of article submission for publication.

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