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Age and Sex Differences in the Associations Among Socioeconomic Status, Affective Reactivity to Daily Stressors, and Physical Health in the MIDUS Study

Yanping Jiang, PhD[1,2] · Katherine M. Knauft, PhD[3] · Clarissa M.E. Richardson, PhD[4] · Tammy Chung, PhD[1,5] · Bei Wu[6] · Samuele Zilioli, PhD[3,7]

[1]Center for Population Behavioral Health, Institute for Health, Health Care Policy and Aging Research, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA
[2]Department of Family Medicine and Community Health, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA
[3]Department of Psychology, Wayne State University, Detroit, MI, USA
[4]Department of Psychology, Illinois College, Jacksonville, IL, USA
[5]Department of Psychiatry, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA
[6]Rory Meyers College of Nursing, New York University, New York, NY, USA
[7]Department of Family Medicine and Public Health Sciences, Wayne State University, Detroit, MI, USA

Yanping Jiang
yanping.jiang@ifh.rutgers.edu

Abstract

Background Low socioeconomic status (SES) is robustly associated with increased risks of morbidity and mortality. Affective reactivity to daily stressors has been proposed to be a mediator for this association. However, few longitudinal studies have empirically tested the indirect effect of SES on health through affective reactivity to daily stressors.

Purpose This study aimed to test the indirect effect of SES on physical health via affective reactivity to daily stressors over a 10-year period and to explore age and sex differences in such indirect effect.

Methods Data were drawn from a subsample of 1,522 middle-aged and older adults (34–83 years of age, 57.2% female, 83.5% White) from the Midlife in the United States study. SES (i.e., education, household income, indicators of financial distress) was assessed in 2004–2006. Affective reactivity to daily stressors was computed using data collected during the 8-day daily stress assessment in 2004–2009. Self-reported physical health conditions were assessed in 2004–2006 and 2013–2014.

Results There was a significant indirect effect of lower SES on more physical health conditions via elevated negative affective reactivity to daily stressors among women but not men. The indirect effect of SES on physical health conditions via negative affective reactivity to daily stressors was consistent across the middle and older adulthood.

Conclusions Our findings suggest that negative affective reactivity to daily stressors might be a key intermediate process contributing to persistent SES disparities in physical health, particularly among women.

Lay summary

Individuals from low socioeconomic backgrounds tend to experience poor physical health, partially because they might be more vulnerable to stress exposure due to limited resources to cope with stress than those from high socioeconomic backgrounds. This study examined the indirect link between socioeconomic status (SES) and physical health through emotional responses following exposure to stress. We also explored whether there were age and sex differences in this indirect link. We analyzed the survey and daily diary data from 1,522 middle-aged and older adults. Individuals reported indicators of SES and a count of medical health conditions. Individuals also reported their experiences of stressors and negative and positive emotions each day over 8 days to capture changes in negative and positive emotions on stressor days versus non-stressor days. We found that among women, but not men, lower SES was related to larger increases in negative emotions on stressor days, which, in turn, was related to more chronic health conditions. Differences in individuals' negative emotions following exposure to daily stressors may be a critical indirect pathway linking SES to physical health.

Keywords Socioeconomic status · Physical health · Affective reactivity · Stress response

Introduction

Health disparities associated with socioeconomic status (SES) are profound and persistent [1]. Low SES has been linked to an increased risk of a variety of poor physical health outcomes, including but not limited to cardiovascular disease [2], diabetes [3], cancer [4], and mortality [5]. Rather than decreasing, there is evidence showing widening SES gaps in physical health [6, 7]. Researchers have been increasingly interested in understanding mechanisms that may account for the SES gradient on physical health [8, 9]. Although environmental resources and health behaviors account for some of the SES disparities in physical health [1], psychological variables—including stress—have been hypothesized as key mediators linking SES to physical health [10].

The Reserve Capacity Model [10] argues that stress exposure and resulting negative emotions are key mechanisms underlying physical health disparities associated with SES. Gallo and Matthews [10] suggest that individuals from low SES backgrounds experience more frequent and more severe stressors in their daily life, which are likely to increase negative emotions and dampen positive emotions, and, in turn, alter the functioning of key physiological systems implicated in physical health, such as the hypothalamic–pituitary–adrenal axis. The pathways highlighted by the Reserve Capacity Model have been supported empirically, with low SES being associated with increased exposure to severe stress in day-to-day life [11, 12], higher levels of negative affect [13], lower levels of positive affect [14], and more daily physical symptoms [15]. Recent evidence testing the full model suggests that negative affect perturbations associated with low SES are related to premature mortality via dysregulations of daily hypothalamic–pituitary–adrenal axis activity [16].

Although existing studies have supported the mediation role of stress exposure in the SES–physical health link [16], few studies have examined to what extent stress response can explain SES disparities in physical health. Some research indicates that individuals with low SES are likely to show more emotional distress following stress than their counterparts with high SES, even when confronting similar stressors [17]. In other words, SES can influence the amount and severity of stressors that individuals encounter and the extent to which they react psychologically and physiologically to the stressors they encounter [17]. A few studies support this idea. For example, following a laboratory-based acute stress induction, individuals with lower SES showed higher physiological stress reactivity [18, 19] and increased fear induction [20]. Recently, Jiang et al. found that lower SES was associated with higher perceived stress and inflammatory reactivity after a human-caused disaster [21]. Indeed, individuals in low SES environments have been found to appraise stressors in their daily lives as more threatening, which may partially explain the SES gradient in health [12].

Affective reactivity is a form of psychological response to daily stressors. One way to study affective reactivity to daily stressors (hereafter referred to as affective reactivity) is to consider the within-individual increase (decrease) in negative (positive) affect that is observed on days in which individuals experience stressors compared with days when they do not [22]. Through this approach, researchers can capture the dynamic interplay between stress and affect to examine the effects of affective reactivity on an individual's health and well-being in naturalistic settings [17]. Previous studies have indicated the effect of affective reactivity on physical health. For example, analyzing data from the Midlife in the United States (MIDUS) study, prior studies have found a significant relationship between negative affective reactivity and all-cause mortality [23, 24]. Negative affective reactivity was also found to be related to the development of chronic health illness [25].

Despite the emphasis frequently placed on the relevance of negative affect reactivity to health, studies have also noted associations between positive affect reactivity and health. For example, in daily diary studies, lower positive affective reactivity is associated with higher inflammation in middle-aged adults [26] and higher mortality risk in older men [27]. These studies suggest that changes in both positive and negative affect following daily stressors are associated with physical health. However, despite these findings and that there is evidence supporting that stress response varies as a function of sociodemographic factors [18, 19], little work has formally examined the indirect pathway from SES to physical health through affective reactivity. A better understanding of intermediate processes underlying the association between SES and physical health is critical for developing interventions to reduce SES health disparities and promote health equity.

Notably, previous studies have indicated individual differences in affective reactivity [28]. Socioemotional Selectivity Theory [29] outlines the myriad ways in which the salience, experience, and regulation of emotion change across the lifespan. Compared with their younger counterparts, older adults tend not to engage in situations that are likely to induce negative affect, and when they experience negative affect, they are more likely to regulate their emotions effectively [30, 31]. For example, older adults show less autonomic reactivity to mood inductions [30], exhibit reductions in affective responses to stress [32], and are more likely to both engage in pro-active coping and perceive daily stressors to be less severe [33]. Furthermore, older adults are more likely to prioritize emotion-related goals and invest more effort toward them than their younger counterparts [34]. Also, although older adults are better able to reduce their experiences of negative social interactions—a form of daily stress, they exhibit heightened cardiovascular reactivity when negative social interactions occur [35]. Given these key differences in the experience of and response to emotions that emerge as a function of age, it is important to examine whether the indirect pathway from SES to physical health via affective reactivity might vary as a function of age.

In addition to age differences, some studies have suggested potential sex differences in affective reactivity to stressors [36, 37], but see [38]. For example, women have been found to report higher levels of negative affect (e.g., fear) and lower levels of positive affect (e.g., happiness) than men following the Trier Social Stress Test [36], a standardized laboratory protocol for inducing stress in humans [39]. Also, a recent study found that women who experienced elevated levels of negative affective reactivity might be at higher risk of developing poor health indexed by systemic inflammation than men [26]. Thus, we also explored the extent to which the indirect pathway from SES to physical health via affective reactivity might differ by sex.

Purpose of the Study

The current study aimed to examine the indirect effect of SES on physical health through positive and negative affective reactivity. We hypothesized that there would be an indirect effect of lower SES on worse physical health via a lower level of positive affective reactivity and a higher level of negative affective reactivity. A secondary purpose of this study was to explore age and sex differences in the above indirect effects. We hypothesized that age and sex would moderate the indirect pathway from SES to physical health via affective reactivity (for the hypothesized moderated mediation model, see Fig. 1). Due to the limited evidence in the prior research, we did not hypothesize specific directions for age and sex differences.

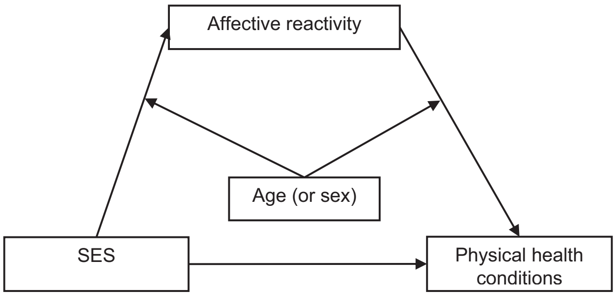

Fig. 1. The hypothesized moderated mediation model in which age (or sex) moderated the indirect pathway from socioeconomic status (SES) to physical health conditions at the third wave of Midlife in the United States (MIDUS) study via affective reactivity. *Note*. SES was assessed using education, household income, and indicators of financial distress. Covariates, including race, marital status, alcohol use, smoking, physical health conditions at the second wave of MIDUS, number of stressors, and affect on non-stressors days, were included in the model but were not displayed for simplification.

Methods

Participants

Data were drawn from the second wave of the National Study of Daily Experiences (NSDE 2, N = 2,022), a subproject of the second wave of Midlife in the United States (MIDUS 2). The MIDUS is a national longitudinal study on healthy aging among 5,555 adults in the USA, including the main sample of 4,963 adults and the Milwaukee sample of 592 African American adults [40]. The Milwaukee sample was recruited from Milwaukee, Wisconsin, to oversample African Americans in the MIDUS main sample. Participants who completed the MIDUS 2 phone interview and self-administered questionnaires between 2004 and 2006 were eligible to participate in NSDE 2. The NSDE 2 is a daily stress project conducted between 2004 and 2009 that included 8-day daily telephone interviews assessing stress and emotional experiences [41]. Of the 2,022 participants in NSDE 2, 1,522 (75.3%) completed the self-reported physical health conditions at the third wave of the MIDUS study (MIDUS 3) between 2013 and 2014, consisting of the final sample in the current analysis. Of the 1,522 participants, 57.2% were female, and 83.5% were White, with an average age of 55.36 years (range, 34–83 years). Compared with those who did not complete MIDUS 3 survey, participants included in the current analysis were younger, less likely to smoke, had higher SES, and reported fewer health conditions (ps < .05). There were no differences in sex, race, marital status, and alcohol use between participants who completed and those who did not complete the MIDUS 3 survey assessment (ps > .20).

Measures

Socioeconomic status

Due to the multifaceted nature of SES and in line with previous MIDUS studies on SES [42, 43], SES was assessed using two objective indicators, including education and income, and three subjective indicators of financial distress at MIDUS 2. Specifically, participants reported their education level on a 12-point scale (1 = no school/some grade school, 12 = any doctorate/professional degree). Household-adjusted income was calculated by dividing participants' self-reported household income by household size. The three subjective indicators of SES were difficulty in paying monthly bills on a 4-point scale (1 = very difficult, 4 = not at all difficult), availability of money to meet needs on a 3-point scale (recoded as 1 = not enough money, 3 = more money), and satisfaction with their current financial situation on an 11-point scale (0 = the worst, 10 = the best). A composite score of SES was calculated by averaging standardized scores on these five indicators, with higher scores reflecting higher SES.

Affective reactivity to daily stressors

Following previous MIDUS studies [23, 25], affective reactivity was operationalized as differences in levels of positive and negative affect on stressor days compared with non-stressor days. During the 8-day assessment of the NSDE 2, participants were asked to report how accurately each of the 27 emotional states described their mood over the day on a 5-point scale of 0 (none of the time) to 4 (all of the time) using the Affective Scale developed for MIDUS [44, 45]. Of the 27 items, 13 were used to assess positive affect (e.g., extremely happy, enthusiastic), and 14 were used to assess negative affect (e.g., upset, nervous). The Cronbach's alphas ranged from 0.92 to 0.95 for positive affect and from 0.81 to 0.86 for negative affect across the 8 days.

During the 8-day period, participants were also asked to report daily stress experiences using the Daily Inventory of Stressful Events [46]. On each day, participants reported whether they experienced any of the seven scenarios (e.g., had an argument or disagreement with anyone, anything happened at work or school that most people would consider stressful) since yesterday. The days that participants reported experiencing at least one stressor were coded as 1 = stressor days, and the days that participants did not report experiencing any stressors were coded as 0 = non-stressor days. Of the 12,176 possible days, participants provided data on 11,351 days (93.2%), of which 39.5% were stressor days, and 60.5% were non-stressor days. To compute positive and negative affective reactivity, a composite score for positive and negative affect, respectively, was first calculated by averaging scores on corresponding affect items each day. A two-level multilevel model was then carried out to compute affective reactivity as follows, of which affective reactivity was indexed as π_{1j}.

$$(\text{Level 1, day-level}) \quad Affect_{ij} = \pi_{0j} + \pi_{1j}(\text{stressor days}) + \varepsilon_{ij}$$

$$(\text{Level 2, person-level}) \quad \pi_{0j} = \beta_{00} + \mu_{0j}$$
$$\pi_{1j} = \beta_{10} + \mu_{1j}$$

Physical health

Physical health was assessed by asking participants to report whether they experienced any of the 30 physical health conditions, such as cancer, diabetes, HIV/AIDS, and heart disease, in the past year at MIDUS 2 and 3. Following previous MIDUS studies [47], a composite of physical health was calculated by summing the presence of any of the 30 conditions. This approach was chosen because the focus of this study was to examine affective reactivity as a possible pathway connecting SES to physical health (vs. testing whether SES was associated with the development of specific medical conditions). Scores on physical health conditions ranged from 0 to 17 at MIDUS 2 and 0 to 30 at MIDUS 3.

Covariates

Several key demographic and lifestyle covariates related to physical health were included in the analyses [16, 47].

These covariates were sex (0 = male, 1 =female), age, race (Whites vs. African Americans; Whites vs. others [due to a small number of other racial groups]), marital status (0 = others, 1 = married), currently smoking (0 = no, 1 = yes); and regular alcohol use (i.e., ≥3 days per week; 0 = no, 1 = yes). Also, in line with previous studies [23], we included the average number of stressors experienced across the 8-day assessment and the average level of positive and negative affect across all non-stressor days as covariates in the analyses to rule out the possibility that the observed associations between affective reactivity and physical health might be driven by stress exposure or typical experience of affect.

Statistical Analyses

Bivariate correlations between study variables were performed in SPSS 27.0 (IBM Corp., Armonk, NY). Two-level multilevel modeling outlined above was then used to separately compute positive and negative affective reactivity in Mplus 7.0 [48]. Last, mediation analyses and moderated mediation analyses were performed to test the indirect effect of SES on physical health through affective reactivity and age and sex differences in such indirect effect using the PROCESS macro (Models 4 and 58, respectively) in SPSS [49]. The analyses were performed separately for positive and negative affective reactivity. The indirect effect was computed using the product method, and the significance was tested using the bootstrapping approach [50]. The indirect effect was considered statistically significant if the 95% confidence interval (i.e., 5,000 resamples) did not contain 0. Due to the non-normal distribution of physical health conditions at MIDUS 2 and 3, scores for physical health conditions were log-transformed (after adding a constant of 1 to avoid negative values) in the mediation and moderated mediation analyses. The analyses were first performed by controlling for demographic and lifestyle covariates, as well as MIDUS 2 physical health conditions (i.e., partially adjusted model), and then further including the number of stressors and affect on non-stressor days (i.e., fully adjusted model). The incidence of missing data at the person level was 1.1%. Missing data on continuous and categorical variables were, respectively, imputed using the expectation–maximization algorithm and mode imputation. Prior studies show that the expectation–maximization approach may obtain less biased estimates than ad hoc methods (e.g., listwise deletion) [51].

Results

Descriptive Results

Table 1 displays the means, *SD*s, and correlations between study variables. Higher SES was correlated with fewer physical health conditions at MIDUS 2 and 3, a higher level of positive affective reactivity, and a lower level of negative affective reactivity ($ps < .05$). More physical health conditions at MIDUS 2 and 3 were correlated with a lower level of positive affective reactivity ($ps < .05$) and a higher level of negative affective reactivity ($ps < .001$). Older age was correlated with more physical health conditions at MIDUS 2 and 3 and a higher level of positive affective reactivity but a lower level of negative affective reactivity ($ps < .01$). In addition, female participants reported lower SES and more physical health conditions at MIDUS 2 and 3 than male participants ($ps < .001$). Women also reported lower levels of positive affective reactivity ($p = .015$) than men, but there were no sex differences in negative affective reactivity ($p = .069$).

Indirect Effect of SES on Physical Health Through Affective Reactivity to Daily Stressors

The partially adjusted mediation model for positive affective reactivity showed that SES was not associated with positive affective reactivity ($\beta = 0.03$, $p = .24$). The association between positive affective reactivity and physical health conditions at MIDUS 3 was also not statistically significant ($\beta = -0.02$, $p = .25$). SES was associated with physical health conditions at MIDUS 3 ($\beta = -0.10$, $p < .001$). The results remained similar after further adjusting for the number of stressors and positive affect across the non-stressor days (see Table 2, Mediation model). The indirect effect of SES on physical health conditions via positive affective reactivity was not significant (effect = −0.002, 95% CI [−0.005, 0.001]).

The partially adjusted mediation model for negative affective reactivity showed that SES was associated with negative affective reactivity ($\beta = -0.13$, $p < .001$). Negative affective reactivity, in turn, was associated with physical health conditions at MIDUS 3 ($\beta = 0.10$, $p < .001$). SES was also associated with physical health conditions at MIDUS 3 ($\beta = -0.09$, $p < .001$). The results remained significant after controlling for the number of stressors and negative affect on the non-stressor days (see Table 3, Mediation model). The indirect effect of SES on physical health conditions via negative affective reactivity was statistically significant (effect = −0.008, 95% CI [−0.014, −0.003]).

Sensitivity analyses were performed separately for objective SES composite (i.e., mean of *z*-scored education and household-adjusted income) and subjective SES composite (i.e., mean of *z*-scored three financial distress items: difficulty in paying monthly bills, availability of money to meet needs, satisfaction with their current situation). Results showed that both objective and subjective SES were related to negative affective reactivity and, in turn, were associated with physical health conditions. We also found a small but significant ($p = .02$) relationship between subjective SES and positive affective reactivity.

Age and Sex Differences

The partially adjusted moderated mediation model showed that neither age nor sex moderated the association between SES and positive affective reactivity ($\beta = -0.04$, $p = .19$; $\beta = -0.03$, $p = .22$; respectively) or the association between positive affective reactivity and physical health conditions at MIDUS 3 ($\beta = 0.03$, $p = .22$; $\beta = 0.00$, $p = .96$; respectively). The results remained statistically nonsignificant after controlling for the total number of stressors and positive affect on non-stressor days (see Table 2, Moderated mediation models).

In the partially adjusted moderated mediation model for negative affective reactivity, age moderated the association between SES and negative affective reactivity ($\beta = 0.06$, $p = .022$). Specifically, there was a significant negative relationship between SES and negative affective reactivity among younger adults (1 *SD* below the mean age; $\beta = -0.19$, $p < .001$) but not among older adults (1 *SD* above the mean age; $\beta = -0.07$, $p = .084$). Notably, age was treated as a continuous variable in the moderated mediation analyses and as a categorical variable for interpretation purpose. There were no age differences in the association between negative affective reactivity and physical health conditions at MIDUS 3 (β =

Table 1 Mean, *SD*s, and Correlations Between Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Socioeconomic status	–												
2. MIDUS 2 physical health	−.25***	–											
3. MIDUS 3 physical health	−.27***	.64***	–										
4. Positive affective reactivity	.06*	−.07*	−.06*	–									
5. Positive affect on non-stressor days	.13***	−.19***	−.17***	−.11***	–								
6. Negative affective reactivity	−.18***	.15***	.17***	−.01	−.32***	–							
7. Negative affect on non-stressor days	−.19***	.23***	.23***	−.02	−.46***	.30***	–						
8. Number of stressors	.00	.13***	.12***	−.05	−.26***	.26***	.23***	–					
9. Female	−.15***	.16***	.15***	−.06*	.00	.05	.04	.09***	–				
10. Age	.06*	.14***	.14***	.07**	.20**	−.13***	−.10***	−.20***	−.02	–			
11. Married	.21***	−.10***	−.10***	.04	.08**	−.09***	−.14***	−.02	−.17***	.03	–		
12. Smoking	−.19***	.04	.09***	−.03	−.11***	.11***	.13***	.01	−.01	−.13***	−.14***	–	
13. Alcohol use	.13***	−.04	−.03	−.01	−.03	.03	−.01	.06*	−.18***	.03	.03	.05	–
Mean	0.00	2.41	3.01	−0.16	2.83	0.18	0.11	0.54	870[a]	55.36	1,053[a]	188[a]	263[a]
SD	0.72	2.38	2.77	0.03	0.71	0.12	0.20	0.48	57.2[b]	11.28	69.2[b]	12.4[b]	17.3[b]

MIDUS Midlife in the United States.
[a]The frequency of categorical variables.
[b]The percentage of categorical variables.
*p < .05; **p < .01;***p < .001.

Table 2 Mediation and Moderation Analyses for Positive Affective Reactivity to Daily Stressors

Variables	Mediation model				Moderated mediation model (age)				Moderated mediation model (sex)			
	Positive affective reactivity		MIDUS 3 physical health conditions		Positive affective reactivity		MIDUS 3 physical health conditions		Positive affective reactivity		MIDUS 3 physical health conditions	
	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*
Socioeconomic status (SES)	0.05	.070	−0.09	<.001	0.05	.086	−0.09	<.001	0.08	.047	−0.09	<.001
Female	−0.04	.17	0.05	.022	−0.04	.15	0.05	.023	−0.07	.19	0.10	.022
Married	0.03	.35	0.00	.85	0.03	.35	0.00	.90	0.03	.30	0.00	.85
Age	0.10	<.001	0.13	<.001	0.10	<.001	0.13	<.001	0.10	<.001	0.13	<.001
Smoking	−0.02	.47	0.05	.010	−0.02	.54	0.05	.012	−0.02	.48	0.05	.010
Drinking	−0.03	.21	0.00	.91	−0.03	.25	0.00	.89	−0.03	.22	0.00	.91
African Americans	0.02	.57	0.08	<.001	0.02	.50	0.08	<.001	0.01	.40	0.08	<.001
Other races	0.04	.14	0.02	.23	0.04	.17	0.02	.24	0.04	.14	0.02	.23
MIDUS 2 physical health conditions	−0.09	.001	0.48	<.001	−0.09	.001	0.48	<.001	−0.09	.001	0.48	<.001
Number of stressors	−0.06	.021	0.05	.038	−0.06	.023	0.05	.042	−0.06	.021	0.05	.038
Positive affect on non-stressor days	−0.16	<.001	−0.09	<.001	−0.16	<.001	−0.09	<.001	−0.16	<.001	−0.09	<.001
Positive affective reactivity			−0.03	.10			−0.03	.14			−0.03	.37
SES × Age					−0.04	.12						
Positive affective reactivity × Age							0.03	.23				
SES × Sex									−0.05	.31		
Positive affective reactivity × Sex											−0.01	.87
R^2	0.04	<.001	0.36	<.001	0.04	<.001	0.36	<.001	0.04	<.001	0.036	<.001

MIDUS Midlife in the United States.

−0.02, *p* = .45). The moderating effect of age on the association between SES and negative affective reactivity, however, became statistically nonsignificant after controlling for the total number of stressors and negative affect on non-stressor

Table 3 Mediation and Moderation Analyses for Negative Affective Reactivity to Daily Stressors

Variables	Mediation model				Moderated mediation model (age)				Moderated mediation model (sex)			
	Negative affective reactivity		MIDUS 3 physical health conditions		Negative affective reactivity		MIDUS 3 physical health conditions		Negative affective reactivity		MIDUS 3 physical health conditions	
	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*
Socioeconomic status (SES)	−0.11	<.001	−0.08	<.001	−0.10	<.001	−0.08	<.001	−0.11	<.001	−0.08	<.001
Female	0.00	.93	0.05	.026	0.00	.88	0.05	.026	0.01	.78	0.05	.025
Married	−0.01	.60	0.01	.80	−0.01	.59	0.01	.79	−0.01	.81	0.01	.80
Age	−0.06	.013	0.12	<.001	−0.06	.014	0.12	.<.001	−0.06	.010	0.12	<.001
Smoking	0.04	.095	0.05	.017	0.04	.12	0.05	.019	0.04	.089	0.05	.018
Drinking	0.03	.16	0.00	.88	0.03	.19	0.00	.89	0.04	.14	0.00	.88
African Americans	0.01	.70	0.07	.002	0.01	.79	0.07	.002	0.01	.79	0.07	.002
Other races	0.06	.009	0.02	.32	0.06	.007	0.02	.32	0.06	.008	0.02	.30
MIDUS 2 physical health conditions	0.03	.32	0.49	<.001	0.03	.31	0.49	<.001	0.02	.34	0.49	<.001
Number of stressors	0.16	<.001	0.04	.073	0.16	<.001	0.04	.084	0.16	<.001	0.04	.070
Negative affect on non-stressor days	0.26	<.001	0.05	.026	0.26	<.001	0.05	.026	0.26	<.001	0.05	.026
Negative affective reactivity			0.07	.002			0.07	.003			0.07	.003
SES × Age					0.04	.066						
Negative affective reactivity × Age							−0.01	.65				
SES × Sex									−0.06	.009		
Negative affective reactivity × Sex											0.01	.60
R^2	0.18	<.001	0.36	<.001	0.18	<.001	0.36	<.001	0.18	<.001	0.35	<.001

MIDUS Midlife in the United States.

days (β = 0.04, *p* = .066; see Table 3, Moderated mediation model for age). Similarly, sex moderated the association between SES and negative affective reactivity but not the association between negative affective reactivity and physical health conditions at MIDUS 3 (β = −0.07, *p* = .008; β = 0.01, *p* = .67; respectively) in the partially adjusted model. The moderation effect of SES on the association between SES and negative affective reactivity remained significant after controlling for the total number of stressors and negative affect on non-stressor days (β = −0.06, *p* = .009; see Table 3, Moderated mediation model for sex). Specifically, there was a significant negative relationship between SES and negative affective reactivity among women (β = −0.16, *p* < .001), but not among men (β = −0.04, *p* = .35). Conditional indirect effect analyses showed that there was a significant indirect effect of SES on physical health conditions through negative affective reactivity among women (effect = −0.013, 95% CI [−0.024, −0.004]), but not among men (effect = −0.002, 95% CI [−0.008, 0.002]).

Discussion

This study examined the indirect effect of SES on physical health through affective reactivity to daily stressors and tested age and sex differences in this indirect pathway. The results showed that low SES was associated with elevated negative affective reactivity, which, in turn, was related to more physical health conditions at MIDUS 3. Notably, such an indirect effect of SES on physical health through negative affective reactivity was significant among women but not among men. There were no age differences in this indirect effect. Positive affective reactivity did not mediate the association between SES and physical health conditions. Lastly, there were no age or sex differences in the indirect effect of SES on physical health conditions via positive affective reactivity.

In line with the Reserve Capacity Model [10], this study found a small but statistically significant indirect effect of lower SES on more physical health conditions via higher levels of negative affective reactivity. The results remained significant even after controlling for covariates of the number of stressors and average negative affect on non-stressor days, which rules out the effect of stress exposure and individuals' typical affective experience [23]. Our findings add to the existing literature by supporting the intermediate role of negative affective reactivity in linking SES to poor physical health. The significant association between negative affective reactivity and physical health conditions also converges with similar findings in previous studies related to mortality [23, 24] and biological risk factors [26] among individuals with increased negative affective reactivity. In addition, the elevated levels of negative affective reactivity associated with low SES are consistent with evidence from laboratory settings showing increased physiological stress reactivity among individuals from low SES backgrounds [18, 19]. These findings provide converging empirical evidence showing the adverse effect of low SES in diminishing effective regulations in individuals' emotional and physiological responses to stressors.

Given research suggesting age differences in affective reactivity [28], we examined whether the SES–affective reactivity–physical health pathway would differ as a function of age. Analyses without controlling for additional covariates (i.e., total number of stressors and typical levels of negative affect on non-stressor days) revealed a significant moderation effect of age on the association between SES and negative affective reactivity but not on the association between negative affective reactivity and physical health conditions. Specifically, low SES was associated with elevated negative affective reactivity among younger adults but not older adults. One possibility is that older adults may be better at managing their negative emotions elicited by stressors than younger adults [30, 31]. Notably, this moderation effect did not reach statistical significance after controlling for the total number of stressors and typical levels of negative affect on non-stressor days, possibly suggesting that the moderation effect was related to the fact that older adults reported less daily negative affect and stressors than younger adults. There were no age differences in the indirect effect of low SES on poor physical health via affective reactivity in the fully adjusted model. This finding shows that the potential intermediate role of negative affective reactivity in linking SES to physical health may be consistent across middle and older adulthood, at least in our sample. Altogether, our findings indicate that age may not play an important role in the effect of SES on physical health due to increased negative affective reactivity.

Somewhat different from previous studies showing sex differences in negative affect reactivity to acute stressors in laboratory settings [36], this study did not find significant sex differences in negative affective reactivity to daily stressors. However, we found a significant indirect effect of SES on physical health via negative affective reactivity among women but not among men. The moderated mediation analyses showed that such sex differences in this indirect effect might be possibly driven by sex differences in the relationship between SES and negative affective reactivity. We found that female participants with lower SES reported elevated negative affective reactivity, whereas the same association was not found among male participants. In addition, negative affective reactivity predicted more physical health conditions, regardless of sex. Why was there a stronger relationship between SES and negative affective reactivity in women than in men? Although the underlying reasons for such sex differences remain unclear, a possible explanation may be related to sex differences in exposure to stressors and resources. Women tend to experience more ongoing stressors, such as being single parents and caregivers of family members, than their male counterparts [52, 53]. Notably, women from low SES backgrounds may lack resources to cope with these ongoing stressors, putting them in double jeopardy of effectively managing their negative affect in the presence of daily stressors. Future studies are needed to further examine how SES and sex intersect to affect health through affective processes.

Interestingly, we did not find an indirect effect of SES on physical health via positive affective reactivity. Neither the association between SES and positive affective reactivity nor the association between positive affective reactivity and physical health conditions reached statistical significance. This finding is somewhat inconsistent with previous studies documenting a relationship between positive affective reactivity and physical health [26, 27] and the adverse impact of low SES on positive affective reactivity [54]. However, this null result is not surprising, given that some studies have indicated a more detrimental effect of negative affect than positive affect on health [16, 24].

Why might negative affective reactivity, but not positive affective reactivity, be a key intermediate pathway through which SES affects physical health? One possible explanation is that increased negative affect following stressors may be more harmful to physical health than decreased positive affect. Another possible explanation is that there might be important individual differences in the association between positive affective reactivity and health. Notably, we did not find age or sex differences in the indirect pathways from SES to physical health conditions via positive affective reactivity, though older age was associated with more positive affective reactivity. Future studies are needed to investigate whether the impact of positive affective reactivity on physical health may vary across some unexamined individual characteristics in this study. For example, some personality traits, such as core self-evaluation that represents an individual's appraisals of self-worth and capabilities [55], may attenuate the impact of positive affective reactivity on physical health [56]. A study found a stronger relationship between positive affect and physical health among participants with high levels of core self-evaluation than their counterparts with low levels of core self-evaluation [56]. Also, a significant relationship between SES and negative affective reactivity but not positive affective reactivity may be possibly due to a tighter connection between SES and negative affect than between SES and positive affect. For instance, neuroimaging studies have documented links between SES and brain development, particularly the amygdala [57–59], a brain structure critical in regulating responses to negative stimuli [60].

Several limitations have to be acknowledged when interpreting the findings. First, the participants included in the current study had higher SES than the original MIDUS sample, possibly limiting the representation at the lower end of the socioeconomic spectrum. As a result, this study may underestimate the effect of SES on affective reactivity and health. Also, our sample was predominantly White, which limits the generalization of the findings to more ethnically diverse populations and our ability to understand potential racial differences in the indirect pathways examined in this study. Previous studies have shown racial differences in the SES–physical health link [61]. Second, although affective reactivity was assessed after the measurement of SES, the indirect effect reported in this study should be cautiously interpreted due to the fact that we only included affective reactivity assessed at MIDUS 2. A minimum of two assessments of mediators and dependent variables may be needed for a formal examination of mediation [62]. Also, given the potentially fluctuating nature of some SES indicators (e.g., income), differences in the time elapsed between SES and affective reactivity assessment (range: 0.2–4.6 years) may have affected our results. However, it is of note that the strength and direction of the relationship between SES and affective reactivity remained very similar when the time elapsed was included as a covariate in the analyses (results not shown). In addition, affective reactivity was operationalized as fluctuations in positive and negative affect on stressor days versus non-stressor days, which may not accurately reflect real-time affective reactivity to stress. Future studies are needed to replicate our findings using other approaches that allow reporting the presence of stressors and emotional experiences simultaneously (e.g., ecological momentary assessment) [63]. Third, although the SES–health link has been well established, individuals may not be equally affected by low SES [9, 64]. Future research is needed to examine whether the indirect pathway from SES to health via affective reactivity may be attenuated by other psychosocial factors, such as personality traits [56]. Lastly, physical health was operationalized as a count of self-reported medical health conditions in the past year; this operationalization might not capture the potential effect of low SES on the development of specific health conditions through affective reactivity.

This study extends previous research by testing affective reactivity to daily stressors as an intermediate process linking SES and physical health and exploring age and sex differences in these associations. To our knowledge, this study is the first to empirically show that low SES was associated with increased levels of negative affective reactivity, which, in turn, contributed to more physical health conditions over a 10-year follow-up. This study further found that such an indirect effect was more salient among women than men. These findings support that negative affective reactivity, as a critical element of the stress response, may play a key role in contributing to the persistent SES disparities in health. Our findings also indicate that reducing negative emotional reactivity to daily stressors through promoting emotion regulations may be a potential way to promote physical health for middle-aged and older adults, particularly for women from low SES backgrounds.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Yanping Jiang, Katherine M. Knauft, Clarissa M.E. Richardson, Tammy Chung, Bei Wu, and Samuele Zilioli declare that they have no conflict of interest.

Authors' Contributions Yanping Jiang (Conceptualization: Lead; Formal analysis: Lead; Writing – original draft: Lead), Katherine M. Knauft (Writing – original draft: Supporting; Writing – review & editing: Equal), Clarissa M. E. Richardson (Writing – original draft: Supporting; Writing – review & editing: Equal), Tammy Chung (Writing – review & editing: Equal), Bei Wu (Writing – review & editing: Equal), and Samuele Zilioli (Conceptualization: Supporting; Writing – review & editing: Equal)

Data Availability

This study and the analytic plan were not formally registered/preregistered. The data and data collection materials are publicly available and can be accessed at https://www.icpsr.umich.edu/web/pages/NACDA/midus.html. The analytic code used for this study is not available in a public archive but will be available upon request to Yanping Jiang, PhD (yanping.jiang@ifh.rutgers.edu).

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