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Complex interplay between health and successful aging: Role of perceived stress, resilience, and social support

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Abstract

Psychological and psychosocial resources, including resilience and social support, have traditionally been studied in the context of the stress paradigm and, more recently, in the context of successful aging. This study used moderated mediation analyses to examine the role of perceived stress in the relationships between physical and mental health functioning and self-rated successful aging (SRSA), and whether differences between people in level of resilience and social support changes the role of perceived stress in these relationships. A cross-sectional study of 1,006 older adults (Mean=77 years) completed scales addressing SRSA, physical and mental health functioning, perceived stress, resilience, and social support. Results indicated that the strength of relationships between both physical and mental health functioning and SRSA were reduced after accounting for variation in level of perceived stress. The role of perceived stress in the association between mental health functioning and SRSA was found to be stronger among participants with the highest levels of resilience, and the influence of perceived stress on the degree of relationship between physical health functioning and SRSA was stronger among those with greatest social support. These findings suggest that interventions to reduce perceived stress may help break the link between disability and poor well-being in older adults. The findings further suggest that the impact of such interventions might differ depending on psychological resources (i.e., resilience) for mental health disabilities and external resources (i.e., social support) for those with physical health problems. The complex interplay of these factors should be taken into account in clinical settings.

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Keywords

Aging; Perceived Stress; Resilience; Disability; Emotional Health; Psychosocial Functioning

1. Introduction

Levels of physical and mental health are important contributors to subjective well-being in late life. Successful aging is a way to conceptualize overall well-being in older adults. Successful aging is no longer considered merely longevity or absence of disease or disability, but rather has been theorized to include various states of well-being with multiple determinants(1, 2). The National Institutes of Health have identified a growing interest in patient-reported outcomes in physical (PH) and mental health (MH)(3), and self-rated successful aging (SRSA) has been described as a meaningful way for individuals to assess and integrate the multi-dimensional components of their past, present, and future(2, 4). From a mechanistic perspective, the achievement of SRSA can be enhanced through the various pathways of health functioning(5). Indeed, several models of successful aging have been proposed involving complex associations between physical, cognitive, emotional, and psychosocial functioning. Doyle et al.'s model(6) consists of objective and subjective components to successful aging, including physical function, activity, social engagement, and psychological traits, with particular emphasis on resilience and social engagement. Our research group previously found support for a model in which level of SRSA was a downstream effect of the complex interactions between psychosocial protective traits (including resilience), PH, and MH(7). Another study found that positive psychological factors, such as resilience and self-efficacy, were predictive of future quality of life in older adults(8).

The centrality of resilience (i.e., "ability to bounce back from the variety of challenges that can arise in life"(9, p. 1026)) to many models of well-being among older adults raises the question of how stressful life events and individuals' responses to these may play a role in successful aging. Unsurprisingly, high and/or chronic stress has been found to negatively influence well-being in older adults(10-13). It has been suggested that perceived stress (i.e., subjective report of how stressful life situations are) has a bidirectional relationship with health and well-being outcomes such that perceived stress can lead to decline in health and sense of well-being, and, conversely, health problems and sense of poor well-being can cause one to appraise circumstances as exceptionally stressful(14). Additionally, it has been reported that health problems may only affect well-being and successful aging if a person *perceives* their health problems as stressful(15). Collectively, the literature suggest that PH and MH relate to subjective well-being in late life, and point to a potential role of perceived stress in mediating these relationships, perhaps influenced by level of resilience and social support (i.e., the frequency of social interactions). To date, however, researchers have not considered the complex interrelationships between all of these factors.

Building on previous research, the present study had three objectives. First we investigated whether PH and MH were related to SRSA in a sample of older adults. Next, we examined whether or not the strength of these relationships would be changed by accounting for

variation in levels of perceived stress. We hypothesized that perceived stress would serve an intermediary role between health and SRSA, thereby weakening the direct relationship between these factors. Such a finding would provide preliminary support for the notion that perceived stress is a pathway through which health affects well-being among older adults. We wish to acknowledge that while some researchers believe that mediation and moderation analyses cannot be done with cross-sectional data, we feel that, although there are inherent limitations to these analyses with cross-sectional data, they provide useful information for future hypothesis-based longitudinal or intervention studies. Our final objective was to investigate the role of resilience and social support, both widely cited stress buffers, in the health→perceived stress→successful aging association. Specifically, we tested models examining the degree to which the potential influence of perceived stress on the strength of the association between health and SRSA might be altered depending on the participants' level of resilience or social support. We expected that, among those with higher levels of resilience and social support, the strength of association between health and SRSA would be more diminished by accounting for simultaneous relationships of these measures with perceived stress.

2. Method

2.1. Participants

This study was approved by the University of California, San Diego (UCSD) Institutional Review Board, and all the participants signed a written informed consent. One thousand and six middle-aged and older adults participated in the Successful AGing Evaluation (SAGE) study. To study successful aging in a community-dwelling sample of adults living in San Diego county, SAGE used a structured multi-cohort longitudinal design(2); cross-sectional data from the first round of survey collection are used here. To be eligible for enrollment, participants were required to be 50 years of age or older, have a telephone in the home, be physically and mentally able to participate in both a phone interview and paper and pencil mail survey, and be fluent in English. Participants were excluded if they resided in a nursing home or skilled nursing facility or were previously diagnosed with dementia or a terminal illness.

2.2. Measures

The following measures from the self-report mailed survey were included in this study:

2.2.1. Self-Rated Successful Aging—Participants were asked to rate themselves in terms of successful aging on a single-item, 10-point scale with 1=*least successful* and 10=*most successful* (16). The rationale for having participants provide their own definition of successful aging, and not have the researchers provide a definition, has been previously described(2).

2.2.2. Physical and Mental Health Functioning—PH and MH functioning were obtained from the Medical Outcome Study 36 Item Short-Form version 1.0 (MOS-SF-36; 17). The SF-36 consists of eight health and well-being scales and provides both a PH and

MH component score. Component scores were used in this study, with higher scores reflective of better functioning on both components.

2.2.3. Perceived Stress—Participants completed the 10-item Perceived Stress Scale (PSS; 18) to evaluate their thoughts and feelings about stressful life events that occurred during the past month. Higher scores indicate greater perceived stress.

2.2.4. Resilience—Resilience was assessed with the Connor-Davidson Resilience Scale-10 item (CD-RISC-10; 9), which asks participants to indicate how confident they are in dealing with life's challenges, with higher scores indicating greater resilience.

2.2.5 Social Support—The Duke Social Support Scale-Social Interaction subscale (DSSI; 19) was used to assess participants' amount of social support. Higher scores indicate a greater number of social interactions.

2.3. Data Analysis

SPSS Statistics Version 20 was used for all analyses. Variables were examined for deviations from normality with the adjusted Fisher-Pearson standardized third moment coefficient(20), with values greater than 1.25 considered significantly skewed. The following skewed variables were log transformed to normalize their distributions: SF-36 PH and MH, SRSA, and CD-RISC-10. Pearson correlations were conducted to analyze the relationships between the study variables. Then we examined whether accounting for shared variation between perceived stress and measures of health and SRSA diminished the strength of the direct relationship between these variables. This is tested through comparing the direct relationship between PH or MH and SRSA (path c vs path c') in models with and without indirect paths (paths a and b) going through perceived stress (see Figure 1). A significant intermediate role of perceived stress is indicated if the direct PH/MH to SRSA relationship is significantly lower in the model that includes perceived stress ($c' < c$). This pattern of results would suggest the possibility that perceived stress mediates the relationship between health and SRSA, although longitudinal intervention studies would be necessary to determine causal links. Next, a series of analyses were conducted to test our hypotheses about how participant characteristics (resilience and social support) may influence the degree to which perceived stress plays an intermediate role in the associations between health and SRSA. For these analyses, we used the moderated-mediation framework described by Preacher, Rucker, and Hayes(21). Specifically, we examined whether the strength of perceived stress' role was different (i.e., moderated) dependent on level of resilience and social support. Models such as those in Figure 1 were constructed, which additionally included paths from the interaction of PH/MH and participant characteristics to perceived stress and SRSA (a_3 and c'_3). If the path strength from the interaction to perceived stress (a_3) is significant, this indicates that the relationship of PH or MH to perceived stress may differ under higher versus lower resilience or social support. Although such effects could also exist along the pathway from perceived stress to SRSA, we focused on the first pathway because we assumed that the variables we chose would have their moderating effects between the stressor of PH and MH and the person's perception of that stress. The degree to which levels of resilience and social support may alter the strength of the direct

relationship between health and SRSA was also tested in these models by examining path c'_3 .

All variables were centered prior to model entry. Linear regression analyses were used to identify coefficients for individual paths, and the Sobel test with a 95% confidence interval was used for our test of the influence of the intermediate variable, perceived stress(22). We used the SPSS macro for moderated mediation, Model 2, developed by Preacher, Rucker and Hayes(21). For our analyses, 5,000 bootstraps were conducted for each model to estimate the sampling distribution of the conditional indirect effect¹, with bias-corrected and accelerated confidence intervals. In the models where path a_3 was significant, we used the Johnson-Neyman (J-N) technique to determine whether it was at low, medium, or high levels of resilience/social support that the relationship of health to perceived stress was altered (21). In additional follow-up analyses, we created separate models specifically comparing the direct and indirect associations between health, perceived stress, and SRSA at high and low levels of resilience or social support to better understand any conditional indirect effects. High values of social support or resilience were created by subtracting one standard deviation from the centered variable, and low values were created by adding one standard deviation to the centered variable. These follow-up models were run using the same SPSS macro as the original models. In each of our analyses, age, gender, education, and race/ethnicity were entered as covariates.

3. Results

Summary statistics for participant clinical characteristics and correlations among study variables are presented in Table 1. All study variables were highly correlated, with a Bonferroni-adjusted critical value of $p < 0.003$ to control for multiple comparisons ($0.05/13 = 0.003$), with the exception of the correlations between PH and social support and MH and social support. Of most relevance to our study goals, we found that individuals who reported worse PH and MH had lower SRSA.

Role of perceived stress

The direct relationships between both PH and MH and SRSA were significantly weakened, as indicated by results of the Sobel test (PH: $z = -5.60$, $p = 0.000$; MH: $z = -9.59$, $p = 0.000$), after accounting for shared variance with perceived stress. The association between PH and SRSA was reduced from $B = 1.71$, $SE = 0.20$ ($p = 0.000$) to $B = 1.30$, $SE = 0.19$ ($p = 0.000$), and the association between MH and SRSA was reduced from $B = 2.23$, $SE = 0.26$ ($p = 0.000$) to $B = 0.14$, $SE = 0.31$ ($p = 0.65$).

Influence of resilience and social support on role of perceived stress in the relationship between physical health functioning and self-rated successful aging

Results from these models are presented in Figures 2 and 3. In Figure 2, the IV was PH, the DV was SRSA, the intermediate variable was perceived stress, and resilience was tested for its influence on the relationship of PH to perceived stress. As in the correlational analysis,

¹According to Preacher, Rucker, and Hayes (2007, p. 186), conditional indirect effects are “the magnitude of an indirect effect at a particular value of a moderator.”

both sides of the indirect path between PH and SRSA through perceived stress were significant in this model, such that those with better PH had lower perceived stress and those with lower perceived stress had higher SRSA. Although significantly reduced in magnitude in the simple model, the direct path (c'_1) from PH to SRSA remained strong and significant in the model that included resilience. More resilient participants had lower perceived stress and higher SRSA in this model, but level of resilience did not alter the relationship of PH to SRSA (path c'_3) nor was there evidence that the relationship of PH to perceived stress was different dependent on level of resilience (path a_3). Therefore, posthoc analyses for conditional indirect effects were not performed.

Figure 3 included social support instead of resilience. The indirect paths (a_1 and b_1) from PH to SRSA via perceived stress were significant, as was the direct association (c'_1) between PH and SRSA. Those with higher social support had less perceived stress and higher SRSA, as in the univariate correlational analyses. The direct relationship between PH and SRSA did not appear to differ depending on one's level of social support, but significant conditional indirect effects on the influence of perceived stress were observed (path a_3). Specifically, posthoc analyses revealed that, at low levels of social support, accounting for perceived stress did not diminish the strength of the direct relationship between PH and SRSA (bootstrapped 95% confidence interval for conditional indirect effects: $-0.01, 0.56$), but when levels of social support were moderate to high, accounting for perceived stress did significantly weaken the PH-SRSA relationship (bootstrapped 95% confidence interval for conditional indirect effects at moderate social support: $0.22, 0.63$ and high social support: $0.34, 0.80$). To further clarify this distinction, we used the J-N technique, which indicated that the conditional indirect effect transitioned from non-significant to significant (using $\alpha=0.05$) at DSSI=6.53, and the conditional indirect effects steadily increased from 6.53 to 12 (range of DSSI scores: 4-12). In other words, the role of perceived stress in explaining the association between PH and SRSA appeared to be strongest among those with high levels of social support.

Influence of resilience and social support on role of perceived stress in the relationship between mental health functioning and self-rated successful aging

These models are presented in Figures 4 and 5. Figure 4 included resilience, and evidence was again found that including an indirect association with perceived stress weakened the direct association between MH and SRSA (with the c'_1 path becoming non-significant), similar to our findings in the simpler model. There was also evidence that more resilient individuals had lower perceived stress and higher SRSA, and that the positive relationship between MH and SRSA was stronger among those with greater resilience (path c'_3). A significant conditional indirect effect of resilience level on the role of perceived stress in the model was also observed (path a_3). Specifically, posthoc analyses showed that, with increasing resilience levels, the degree to which accounting for perceived stress diminished the strength of the relationship between MH and SRSA steadily increased from low [CD-RISC-10 score=0.38, 1.04], to moderate [CD-RISC-10 score =0.54, 1.30], to high levels of resilience [CD-RISC-10 score =0.67, 1.59]. Posthoc analyses using the J-N technique were also conducted to examine the strength of the conditional indirect effects at all levels of

resilience, and provided further support for the conditional indirect effect increasing from low to high resilience.

Social support was examined in our final model (Figure 5). Accounting for perceived stress was again found to diminish the strength of the direct relationship between MH and SRSA. Individuals with low social support had greater perceived stress and lower SRSA. The strength of the direct association between MH and SRSA was not different depending on one's level of social support (path c'_3), nor was there evidence that level of social support influenced the degree to which perceived stress was associated with MH and therefore the role perceived stress played in reducing the relationship between MH and SRSA (path a_3).

Further clarification of conditional indirect effects

Figure 6 demonstrates the conditional indirect effects between PH and SRSA when social support is high versus low (figure 6a and 6b) and between MH and SRSA when resilience is high versus low (figure 6c and 6d). As seen in the figures, at low levels of social support or resiliency there continues to be a role for perceived stress in contributing to the associations between health and SRSA, but when these factors are high, perceived stress is a less influential player in the model.

4. Discussion

As hypothesized, the relationship between worse physical and mental health functioning and lower well-being, as measured by self-rated successful aging, was weakened when associations between these factors and perceived stress were taken into account. This provides preliminary cross-sectional evidence that declines in physical and mental health may lead to greater perceived stress, which in turn would decrease perceptions of well-being and successful aging. We found only partial support for the idea that levels of the potentially buffering variables of social support and resilience influenced the magnitude of the role of perceived stress. Among those with higher social support, good PH is more strongly related to low perceived stress, and thus the indirect path from PH to SRSA via perceived stress is more influential than it is among those with low levels of social support. Resilience, on the other hand, influenced the role that perceived stress played in the link between MH, but not PH, and SRSA. In this case, there was evidence at all levels of resilience that poorer MH leads to poorer SRSA primarily through the associations of both of these with greater perceived stress. There was significant moderation because the higher one's resilience, the stronger the evidence for an intervening role of perceived stress.

There are limitations to this study that need to be taken into account when interpreting the results. First, in terms of the population, our sample was primarily Caucasian and results cannot be generalized to other racial/ethnic groups. There may also be a selection bias in that those individuals who agreed to participate may be functioning better than those who refused to participate. Another possible selection bias is that our sample consisted of community-dwelling older adults, and the degree of MH, PH, resilience, social support, and SRSA may be higher in these participants than in the general population of older adults, in which a percentage reside in assisted living, nursing homes, or skilled nursing facilities. Next, the cross-sectional design precludes determination of causal relationships with any

certainty. While true tests of mediation imply causality through the use of longitudinal data, it is also important to establish covariation in variables. According to Preacher and Hayes(23), correlation is a necessary condition for establishing mediation. Since our large dataset was cross-sectional in nature, for the purposes of building models that might make helpful predictions about likely results from longitudinal data, we assumed ordering of effects (e.g., that health→perceived stress→SRSA) based on theory and previous research. There are likely to be some bi-directional effects. As we were not able to test whether our directional assumptions are correct, longitudinal follow-up is needed to take the next step in determining the direction of causal relationships. Another limitation is the use of self-report-based assessments for all measures. A concern that has emerged with self-report measures is the tendency to provide socially desirable responses that may impact instrument validity. However, in previous work we found an absence of correlations or small relationships ($r<0.25$) between a social desirability bias measure and the scales in this study(24). There can also be a tendency for people to respond in a similar manner (e.g., response set) across scales when completing multiple self-report instruments. However, although the correlations between PH, MH, and SRSA were significant, they were modest (all below $r=0.3$; see Table 1), indicating a lack of a strong responding bias. A final limitation is that the SF-36 is a generic PH and MH measure. Future work would benefit from objective and subjective health-related quality of life instruments designed for use with older adults as well as to specifically address mental health problems, such as the Geriatric Depression Scale. Notwithstanding these limitations, the results of our analyses have potentially important clinical implications for patients with physical or mental problems and/or disability. In patients with high levels of perceived stress due to physical or mental disability, interventions targeted at decreasing perceived stress may be beneficial.

Since we found social support and resilience to influence the role of perceived stress in the relationships between health and SRSA, a further clinical implication is that a treatment focused solely on reducing perceived stress without focusing on the larger context of the interacting psychological factors may be less effective. If a patient presents with low social support or low resilience, focusing on improving perceived stress may be a less effective way to improve well-being than if the patient presented with high social support or resilience. Specifically, for patients with *physical impairment and/or disability* who present with low social support and high perceived stress, it may be important to design an intervention that combines components of stress reduction and increasing social support. On the other hand, for patients with *mental health problems* who present with low resilience and high perceived stress, a treatment that combines components of stress reduction and resilience-enhancing interventions may be most effective.

In conclusion, these data highlight the complex interplay between health, perceived stress, resilience, and social support on subjective well-being, and suggest that interventions to reduce perceived stress may help break the link between disability and poor well-being in older adults. The existence of additional factors which may alter the nature or strength of perceived stress' role suggests that such interventions should also aim to improve internal psychological resources (i.e., resilience) for mental health problems and enhance external resources (i.e., social support) for those with physical health problems.

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Figure 1.
Example models of the relationships between IV, DV, Intermediate Variable, and Participant Characteristics

Figure 2.
Model including Physical Functioning, Resilience, and Perceived Stress

Figure 3.
Model including Physical Functioning, Social Support, and Perceived Stress

Figure 4.
Model including Mental Health Functioning, Resilience, and Perceived Stress

Figure 5.
Model including Mental Health Functioning, Social Support, and Perceived Stress

Figure 6. Models of conditional indirect effects at high and low levels of social support (6a and 6b) and high and low levels of resilience (6c and 6d).

Table 1

Summary of Clinical Measures and Correlations Among Variables (N=1,006)

Clinical Characteristics	Possible Range of Scores	Mean(SD)
Self-Rated Successful Aging (SRSA)	1-10	8.19(1.47)
Physical Functioning (SF-36-PC)	0-100	42.72(11.55)
Mental Health Functioning (SF-36-MC)	0-100	54.46(9.35)
Perceived Stress (PSS)	0-40	12.26(5.41)
Resilience (CD-RISC-10)	0-40	31.13(6.32)
Social Support (DSSI-SI)	4-12	8.64(1.59)

Correlations Among Study Variables					
	1. SRSA	2. SF-36-PC	3. SF-36-MC	4. PSS	5. CD-RISC-10
1. SRSA	--				
2. SF-36-PC	0.26*	--			
3. SF-36-MC	0.25*	-0.12*	--		
4. PSS	-0.38*	-0.20*	-0.59*	--	
5. CD-RISC-10	0.41*	0.22*	0.38*	-0.58*	--
6. DSSI-SI	0.20*	0.09	0.04	-0.11*	0.17*

Note: Correlation values reported in Pearson r;

*
p < 0.003.

SRSA=Self-Rated Successful Aging; SF-36 PC=Physical Component; SF-36 MC=Mental Component; PSS = Perceived Stress Scale; CD-RISC-10 = Connor-Davidson Resilience Scale-10 item; DSSI-SI = Duke Social Support Index-Social Interactions.