Exploring buffering effects of interpersonal relationships on the impacts of stress on physical health

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Abstract

We examined the potential moderating effects of interpersonal relationships on the association between stress and physical health. We hypothesized that there would be a significant main effect of stress on physical health, a significant main effect of relationships on physical health, and a significant interaction between stress and relationship quality on physical health, such that quality relationships provide a buffering effect, reducing the negative impacts of stress on physical health. Data was collected through a self-report Qualtrics survey on CloudResearch. We found a significant main effect of stress on physical health and a significant main effect of relationship quality on physical health. An interaction was only observed in romantic relationship subtypes, such that low-quality romantic relationships exhibit a greater decline in physical health than high-quality romantic relationships in conditions of low compared to high stress. Important implications exist in which enhancing relationship quality could be a vital strategy in mitigating stress-related health consequences. This may include therapeutic interventions, socioemotional-based school curricula, and holistic healthcare opportunities.

Keywords: stress, interpersonal relationships, relationship quality, close relationships, health, physical health

1 INTRODUCTION

An estimated 62% of women and 51% of men between the ages of 18-34 stated that most days, they are completely overwhelmed by stress[1]. This trend, in conjunction with research suggesting potential links between stress and negative physical health outcomes, such as cardiovascular diseases and diabetes[2], draws concern toward the need to mitigate the negative impacts of stress on physical health. In the present study, we will investigate the potential moderating effects of quality interpersonal relationships, including familial, romantic, and friendship, on the relationship between stress and physical health.

1.1 Effects of Stress on Chronic Physical Health Outcomes

High stress can impact many realms of physical health, regardless of how long ago one was exposed to the stress. Childhood stress (e.g., violence, abuse, divorce, etc.), especially exposure to intense and chronic stressors (e.g., war), can have lasting psychological effects, but *also* lasting neurobiological effects, immune dysfunction, and a reduced lifespan[3,4]. Similarly, high levels of stress can lead to increased smoking habits, sleep disorders, substance use, eating disorders, and a generalized weakned immune system[3].

Socioemotional stress places physical stress on the body, disrupting its ability to engage in homeostatic regulation, thus leading to an increased potential for adverse health outcomes. This is evident in the overactivation of the hypothalamic-pituitary axis that is initiated by stress and results in the hypersecretion of cortisol, the stress hormone[5]. Altering key homeostatic regulatory systems leads to downstream dysfunction of various biological processes, including tissue damage and bodily overload, dysregulation of the autonomic nervous system, elevated heart rate and blood pressure, and weakened immune functioning[5].

Ultimately, stress has the capability to alter many aspects of healthy functioning, placing bodily systems at an increased susceptibility to disease, infection, and dysfunction[5]. This is evident in one study which related daily stress levels to "healthiness," as operationalized by the frequency of pathologies including the flu, sore throat, headache, and pain[6]. Research suggested a possible positive correlation between daily stress and

"healthiness" such that as daily stress increased, so did the occurrence of various pathologies[6].

Similarly, research also points to potential correlations between stress and specific pathologies because of the biological dysfunction stress induces. For example, one 2013 study found that people who reported a higher baseline stress level were 2.12 times more likely to have a myocardial infarction[7], suggesting that stress may increase the risk of cardiovascular problems. Notably, this is important in addressing how daily stress can result in chronic health complications.

Another study found potential impacts of stress on female reproductive endocrinology and subsequent fertility, suggesting that the oxidative stress induced by chronic daily stress disrupts ovarian cycles, leading to a higher risk of developing polycystic ovary syndrome (PCOS)[8]. Similarly, women who score higher on perceived stress scales prior to in vitro fertilization (IVF) treatments are less likely to become pregnant than those who score lower[9]. As a result, research suggests that stress negatively relates to the number of viable oocytes[9], thus decreasing the probability of successful fertilization. Stress plays a crucial role in the regulation of bodily homeostasis, and when unchecked it poses the ability to induce a variety of chronic negative downstream physical health effects across body systems.

1.2 Effects of Supportive Relationships on Mitigating Stress

Research suggests that supportive relationships may improve physical health outcomes which are negatively related to stress. Some research explains this connection through the ability of relationships to mitigate the upstream instigator of physical health decline: stress itself.

The leading theory on the mechanism by which relationships reduce stress is referred to as *stress buffering*. Stress buffering suggests that positive aspects of relationships, such as social support and social integration, "block" the negative impacts of stress[10]. Put simply, social support makes it easier to cope with stress, thus limiting its ability to initiate harmful downstream effects.

Additional research addresses the social support aspects of stress buffering through the framework of coping assistance[11]. This research suggests specific interventions for the stress that relationships provide. These include having a support person to intervene, distract and provide reassurance in a multitude of stressful situations[11].

These theories were put into practice in a 2021 study in which students were experimentally exposed to varying conditions of emotional support and subsequently assessed on their levels of academic stress. Results supported theories of stress buffering and coping assistance, displaying that students who were educated on effective social support strategies reported less academic stress than the control group who received no education on effective strategies[12].

Experimental support of these theories provides an interesting framework for the ability of relationships to reduce stress, which creates the potential to explore how stress reduction improves health, and ultimately suggesting that relationships may serve as a moderator in the stress-physical health axis.

1.3 Effects of Relationship Quality on Physical Health Outcomes

In addition to the negative consequences of stress on physical health discussed above, some research suggests that quality relationships may induce positive consequences on physical health. Psychological studies regarding the how of the stress and relationship axis seek to learn what variables are responsible for the benefits of interpersonal relationships on health.

On the most basic level, healthy relationships have the capacity to direct positive social norms which support health. For example, adopting habits such as quitting smoking, being health conscious, and visiting a doctor are all important to one's personal well-being and health[13]. While the support of these general practices inherently encourages health as a primary effect, some research also investigates corresponding physiological changes that improve specific health outcomes.

For example, research suggests that romantic relationships may improve cardiovascular functioning by lowering blood pressure[14]. This is exemplified in a 2019 experiment where participants who could consult with their partner during a stressful task presented with lower blood pressure readings during the task than those in the control group with no partner influence[14]. Given the existing literature suggesting negative relationships between stress and cardiovascular health, identifying potential protective factors is critical.

Another study implies that relationships are closely intertwined with the immune system, exhibiting the potential to boost immune functioning and better protect the body from infection[15]. The suggested mechanism explains that social exposure and connection upregulates the antiviral response of the immune system, ultimately making the body better equipped to identify and target pathogens which may negatively impact health[15].

Some research even goes as far as to suggest a positive correlation between healthy attachment styles and life expectancy[16]. Although these findings are less notable, the abundant literature on the positive impacts of relationships on physical health speaks volumes about the positive impacts of healthy relationships.

1.4 Intersection of Quality Interpersonal Relationships, Stress, and Health

While the connections between stress and physical health, relationships and physical health, and relationships and stress, have been well established, as discussed above, less conclusive research exists on the dynamic between all three factors. This study seeks to add to and clarify existing literature on the interplay of stress and relationship quality on physical health outcomes.

Additionally, while previous literature does exist addressing subsets of relationship types individually, to our knowledge no such study exists comparing the buffering effects of different relationship types within one research design. This study will explore how the significance of any potential buffering effects of a relationship on the stress-physical health axis varies across relationship subtypes including romantic, familial, and friendship.

From a clinical perspective, better understanding the relationship between stress, physical health, and relationship quality offers opportunities to better inform health-conscious practices. Given the associations previously discussed between stress and quality relationships, targeting the development and maintenance of high-quality relationships may be an effective upstream therapy for adverse physical health conditions. Primarily, mental health providers can tailor their strategies for clients to focus on improving their own health amidst stressful circumstances. This is essential for examining health in a broader context with a holistic approach. In addition, practitioners can introduce family/couples therapy in a way that is supported by both physical and mental health research. In the education realm, this study is essential to provide new insights into social-emotional learning among different types of relationships. By researching the impact of relationships on stress and health, public knowledge as well as school curricula can drastically improve and be tailored to more specific strategies for the community and students.

1.5 Overview of the Current Work

We assessed perceived stress, physical health, and relationship quality among familial, romantic, and friendship dynamics through self-report questionnaires to analyze the potential main effects of stress and relationship quality on health and the potential interaction of stress and relationship quality on physical health.

Based upon the existing literature outlined above we hypothesized that (1) there would be a significant main effect of stress on physical health, such that higher stress levels correlate to lower levels of physical health and (2) there would be a significant main effect of relationships on physical health, such that higher quality relationships correlate to higher levels of physical health.

Additionally, given the potential overlap between bivariate studies on stress and relationships, and health and relationships, as outlined above, we predicted that (3) there would be a significant interaction of stress and relationship quality on physical health such that quality relationships provide a buffering effect, reducing negative impacts of stress on physical health. We also conducted exploratory analyses to analyze how different types of relationships, including familial, romantic, and friendship, would act on physical health through the proposed buffering effect.

2 METHODOLOGY

2.1 Methods

In conducting the reported research, the ethical guidelines of the American Psychological Association were followed, and the research was conducted following exemption by the Institutional Review Board at the University of Denver. The rights of the participants were protected throughout the study. All measures, manipulations, and exclusions are disclosed. The reported study was preregistered (https://aspredicted.org/xt7bm.pdf)[1].

2.2 Participants

We recruited 160 participants through Amazon Mechanical Turk, an online participant recruitment platform, using CloudResearch (formerly TurkPrime; see Hauser et al., 2022[17]; Litman et al., 2017[18]; Litman & Robinson, 2021[19]). Each participant was compensated one dollar. Any participant who was +/- four standard deviations from the mean, indicated they did not complete the surveys accurately or carefully, failed one or both of the attention checks, or had a chronic physical disability that impacted their daily life was excluded from the data. Out of the 160 participants, 142 were included in our analysis (16 indicated they had a chronic disability and two failed at least one attention check). We collected demographic information on race, sex, gender, and age (see Table 2). Participant ages ranged from 18 to 74 (M_{age} = 38.00, SD_{age} = 11.13). A sensitivity power analysis conducted in G*Power[20] indicated this sample size (N = 142) could detect a small to medium effect (F = 2.67; f^2 = 0.079) or greater for a multiple regression with three predictors and 80% power.

[1] One of the preregistered hypotheses is not reported in the main text and instead it has been reported in the Appendix (see Appendix A). We did not have enough power to test this effect because our measure of sunlight exposure was limited and drastically reduced our sample size.

2.3 Materials

2.3.1 Perceived Stress Scale (PSS) (modified)

The PSS is a ten-item questionnaire used to assess the amount of stress an individual perceives based on both frequency and intensity measures[21]. Participants self-reported the frequency of stress-related symptoms listed on a scale of zero to four (0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, 4 = very often). We modified this scale to include responses surrounding the intensity of each of the ten symptoms listed as well (see Appendix B). This was also rated on a scale of zero to four (0 = not severe, 1 = mildly severe, 2 = moderately severe, 3 = severe, 4 = very severe). Four of the items were reverse-coded (4, 5, 7, 8). Sample items include "How often have you been upset because of something that happened unexpectedly?" or "How often have you felt that you were unable to control the important things in your life?"[21]. One composite variable was created from the sum of the 20 total items (M = 42.82, SD = 15.30, α = 0.94). Higher values indicate higher stress levels.

2.3.2 Multidimensional Scale of Perceived Social Support (MSPSS)

The MSPSS is a 12-item questionnaire used to assess the quality of the participant's familial, friend, and romantic relationships[22]. It consists of three subscales: familial (Q3, 4, 8, 11; Cronbach's α = 0.95), friends (6, 7, 9, 12; Cronnbach's α = 0.96), and romantic (1, 2, 5, 10; Cronbach's α = 0.97) (see Appendix C). Participants rated how much they agreed with the statements on a scale of one to seven (1 = very strongly disagree, 2 = strongly disagree, 3 = mildly disagree, 4 = neutral, 5 = mildly agree, 6 = strongly agree, 7 = very strongly agree). Sample items include "There is a special person who is around when I am in need," and "My family really tries to help me"[22]. A composite variable was created from the sum of the 12 items (M = 60.89, SD = 16.00, α = 0.94). Higher values indicate better-quality relationships.

2.3.3 36-Item Short Form Health Survey (SF-36) (modified)

The SF-36 is a 36-item self-report questionnaire aimed to assess the physical health of a participant[23]. Participants rated how much they agreed with the statements using one six-item Likert scale (1 = none, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe, 6 = very severe), four different five-item Likert scales (never severe to always severe, excellent to poor, much better to much worse, and not at all to extremely), one three-item Likert scale (1 =limited a lot, 2 = limited a little, 3 = not limited at all) and one Yes/No response. Five of the items were reverse-coded (Q1-2, 20-22). Sample items include "Compared to one year ago, how would you rate your health in general now?" and "How much bodily pain have you had in the past four weeks?"[23]. We modified this scale from a 36-item scale to a 23-item scale by omitting questions not pertaining to physical health (Q 17-19, 23-32) (see Appendix D). A composite variable was created from the sum of the 23 items (M = 64.93, SD = 8.30, α = 0.84).

2.4 Procedure

Participants accessed the study through Amazon Mechanical Turk using CloudResearch (Formerly TurkPrime; see Hauser et al., 2022[17]; Litman et al., 2017[18]; Litman & Robinson, 2021[19]) and were informed that completion of the survey implied their consent to participate. Participants completed three questionnaires regarding current stress levels (PSS[21]; modified), the quality of their interpersonal relationships (MSPSS[22]), and current physical health (SF-36[23]; modified). Participants completed attention checks following the PSS and SF-36 which required them to accurately identify which constructs they had just been assessed on (stress and health) to ensure participants were reading the questions carefully. Then, participants completed demographic measures of their sex assigned at birth, current gender, age, race, and city of residence. Finally, participants were provided the opportunity to share anything else they would like related to the study and validated that they completed the study carefully, such that their data should be used for the analysis of the study. Participants read a debrief form and then were compensated one dollar for their time.

2.5 Analysis Plan

We analyzed relationships between physical health, stress, and quality relationships using a multiple regression analysis. We tested the moderation via PROCESS MACRO, an extension software to SPSS Statistics[24], for total relationship quality using a composite variable of the relationship subscales, as well as each relationship subscale (romance, friendship, familial) on its own. In this case, the relationship type served as the moderator, stress served as the predictor, and physical health served as the dependent variable.

3 RESULTS

We tested three hypotheses: (1) there would be a significant main effect of stress on health such that higher stress levels correlate to lower levels of health, (2) there would be a significant main effect of relationship quality on health such that higher quality relationships correlated to higher levels of health, and (3) there would be a significant interaction between stress and relationship quality on health such that quality relationships provide

a buffering effect, reducing negative impacts of stress on health at higher levels of stress than lower levels of stress. Additionally, we tested whether the buffering effect of relationship quality differed for romantic, family, or friendship relationship subtypes.

3.1 Analyses

3.1.1 Correlational Analysis

Prior to hypothesis testing, we ran correlational analyses with all key variables to see the pairwise relationships between variables (see Table 1). We found significant correlations between stress and health, $r(140) = -.31$, $p < .00$, and relationships and stress, $r(140) = -.23$, $p = .006$. Regarding relationship subtypes, familial and peer relationships also showed significant correlations with stress, whereas romantic relationships did not. There was a significant negative correlation between familial relationships and stress, $r(140) = -.20$, $p = .017$. There was also a significant negative correlation between friend relationships and stress, $r(140) = -.20$, $p = .015$.

The correlational analysis also displayed associations within relationship types (see Table 1). All relationship types had a significant association with each other. There was a significant strong positive correlation between familial and peer relationships, $r(140) = .49$, $p < .001$. There was a strong positive correlation between familial and romantic relationships, $r(140) = .46$, $p < .001$. There was a strong positive correlation between romantic and peer relationships, $r(140) = .52$, $p < .001$.

Demographic information was also collected on sex, gender, race, and age (see Table 2).

3.1.2 The Impact of Stress and Relationships on Health

A moderation analysis was conducted in which physical health was regressed onto stress, quality interpersonal relationships, and their interaction (see Figure 1). All constructs listed were mean-centered before calculating the interaction term. The overall model was significant, $F(3, 138) = 8.57$, $p < .001$. There was a significant negative main effect of stress on physical health, $b = -0.13$, $t(138) = -3.07$, 95% CI [-0.22, -0.05], $p = .003$, such that higher stress levels indicated worse physical health. There was also a significant positive main effect of relationships on physical health, $b = 0.13$, $t(138) = 3.14$, 95% CI [0.05, 0.21], $p = .002$, such that quality interpersonal relationships indicated better physical health. There was no interaction between stress and relationships on physical health, $b = -0.00$, $t(138) = -0.08$, 95% CI [-0.00, 0.00], $p = .936$.

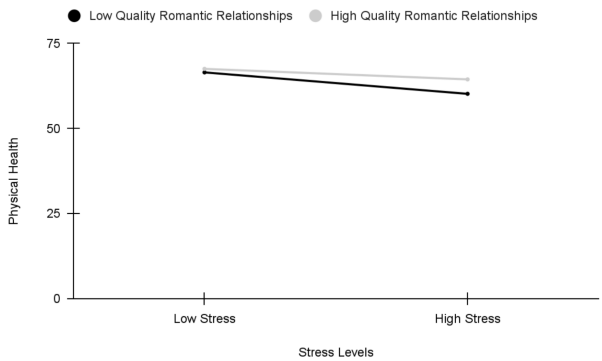
3.1.3 The Impact of Romantic Relationships on Stress and Physical Health

A moderation analysis was conducted in which physical health was regressed onto stress, romantic relationships, and their interaction (see Figure 2). All constructs listed were mean-centered before calculating the interaction term. The overall model was significant, $F(3, 138) = 9.93$, $p < .001$. There was a significant negative main effect of stress on physical health, $b = -0.12$, $t(138) = -2.92$, 95% CI [-0.21, -0.04], $p = .004$, such that higher stress levels were associated with worse physical health. There was also a significant positive main effect of romantic relationships on physical health, $b = 0.26$, $t(138) = 2.83$, 95% CI [0.08, 0.45], $p = .005$, such that better quality romantic relationships were associated with better physical health.

Figure 1. *Stress and Health Moderated by Interpersonal Relationships*

Note. Association between stress, physical health, and relationship quality. Higher levels indicate better physical health.

Figure 2. *Stress and Health Moderated by Romantic Relationships*



Note. Interaction between stress (low and high levels), physical health, and romantic relationships (high and low quality). Greater values along the y-axis indicated better physical health.

There was a significant interaction between stress and romantic relationships on health, $b = 0.01$, $t(138) = 2.10$, 95% CI [0.00, 0.02], $p = .037$. For those who reported higher-quality romantic relationships, there were no differences in physical health between those who reported higher stress levels and those who reported lower stress levels, $b = 6.86$, $t(138) = -0.95$, 95% CI [-0.17, 0.06], $p = .344$. However, for those who report low-quality

Table 1 *Correlation Between Relationship Type, Physical Health, and Stress*

	Mean	SD	Total	Friend	Family	Romantic	Stress
Total	60.84	16.10					
Friend	19.64	6.53	.820**				
Family	20.06	6.43	.794**	.485**			
Romantic	21.14	6.86	.822**	.518**	.464**		
Stress	42.90	15.20	-.230**	-.204*	-.199*	-.157	
Health	64.93	8.30	.315**	.222**	.260**	.285**	-.306**

*p<.05 **p<.01

Note. Correlation analysis between overall relationships, familial relationships, peer relationships, romantic relationships, stress, and physical health levels.

romantic relationships, there is a significant difference in health between those in high-stress and low-stress environments, such that those in high-stress environments with low-quality romantic relationships have the worst health outcomes b = -7.14, $t(138)$ = -4.02, 95% CI [-0.29, -0.10], p < .001. These results suggest that high-quality romantic relationships have the potential to buffer the negative health outcomes associated with high stress, supporting our third hypothesis.

3.1.4 The Impact of Peer Relationships on Stress and Physical Health

A moderation analysis was conducted in which physical health was regressed onto stress, peer relationships, and their interaction. All constructs listed were mean-centered before calculating the interaction term. The overall model was significant, $F(3, 138) = 6.70$, $p < .001$. There was a significant negative main effect of stress on physical health, b = -0.15, $t(138)$ = -3.36, 95% CI [-0.23, -0.06], p = .001, such that higher stress levels indicated worse physical health. Consistent with our hypothesis, there was also a significant positive main effect of peer relationships on physical health, b = 0.22, $t(138)$ = 2.18, 95% CI [0.02, 0.42], p = .031, such that better quality peer relationships indicated better physical health. Inconsistent with our hypothesis, there was no interaction between stress and peer relationships on health, b = -0.01, $t(138)$ = -1.06, 95% CI [-0.02, 0.01], p = .292.

3.1.5 The Impact of Familial Relationships on Stress and Physical Health

A moderation analysis was conducted in which physical health was regressed onto stress, familial relationships, and their interaction. All constructs listed were mean-centered before calculating the interaction term. The overall model was significant, $F(3, 138) = 7.21$, p = < .001, such that family relationship quality moderated the relationship between stress levels and physical health. There was a significant negative main effect of stress on physical health, b = -0.14, $t(138)$ = -3.29, 95% CI [-0.23, -0.06], p = .001, such that higher stress levels indicated worse physical health. There was also a significant positive main effect of familial relationships on physical health, b = 0.27, $t(138)$ = 2.59, 95% CI [0.06, 0.47], p = .011, such that better quality familial relationships indicated better physical health. There was no interaction between stress and familial relationships on health, b = -0.00, $t(138)$ = -0.33, 95% CI [-0.01, 0.01], p = .745. These results provide additional support for our second hypothesis, as they suggest that in addition to peer relationships, better familial relationships can also lead to better physical health. However, similar to peer relationships, they do not support our third hypothesis since there was no interaction.

Table 2 *Descriptive Statistics*

Characteristic	n	%
Race		
Native American	1	0.8
East Asian	23	16.2
South Asian	1	0.8
Hispanic or Latino/a/x	8	5.4
Native Hawaiian/Pacific Islander	1	0.8
Black/African American	15	10.8
White/European American	89	63.1
Bi- or multiracial	1	0.8
None of these options	2	1.5
Decline to share	1	0.8
Sex		
Female	65	45.8
Male	77	54.2
Gender		
Female-identifying	62	43.7
Male-identifying	78	54.9
Nonbinary	2	1.4

Note. N = 142. Participant ages ranged from 18 to 74 (M_{age} = 38.00, SD_{age} = 11.13).

3.2 Exploratory Analysis

3.2.1 Comparison of Effect Sizes Across Relationships

Across relationship subtypes, the romantic subtype had the largest effect size for the effect of relationships on health (f^2 = 0.22), followed by familial relationship effect subtype (f^2 = 0.16), and the friend relationship subtype (f^2 = 0.15). Although the family and friend subtypes were slightly different, the magnitudes only differed by 0.01.

4 DISCUSSION

The present study aimed to explore connections between interpersonal relationships, stress, and physical health, illustrating the potential buffering effects of relationships in reducing the established negative correlation between stress and health[6]. We expected to replicate the previously established negative link between stress and health[6], as well as observe a significant positive main effect of relationship quality on health. Further, we expected a significant interaction between stress and relationship quality on health, such that quality relationships would provide a buffering effect, reducing the negative impacts of stress on physical health.

Our first and second hypotheses were supported. We found that higher levels of stress were negatively associated with physical health and higher-quality interpersonal relationships were positively associated with physical health. This finding was consistent with literature stating that unsupportive family and friend behaviors were associated with greater psychological stress[25].

Interestingly, no interaction was found between stress, health, and a composite score of familial, romantic, and friendship interpersonal relationships; however, we observed an interaction within romantic relationships, suggesting that high-quality romantic relationships may buffer against the negative health outcomes associated with conditions of high stress.

Furthermore, we tested whether the main effects of different relationship subtypes (romantic, familial, and friendship) on health would vary in their significance. We found that each relationship subtype does have a positive effect on health, however, the greatest impact is seen in romantic relationships. Previous literature attempts to relate these findings to the unique physical aspects related to romantic relationships, for example, finding that individuals who receive more hugs more often tend to have less severe illness and stress[26]; however, the rationale for why these trends are observed is unclear. Future research should expand on the mechanisms of how physical touch reduces stress in romantic relationships.

4.1 Application of Findings

The potential ability of romantic relationships to improve physical health outcomes resulting from chronic stress poses valuable insights into supporting the physical health of those experiencing chronic mental illness, short-term transition, and life adversity. This may provide a preventative tool to support strong psychological health among those whose physical health might be negatively impacted. The present research also expands the theoretical understanding of human stress resilience and may provide important insights into why some individuals maintain good health despite experiencing significant stress[27].

Implications of these findings may provide support for enhancing therapeutic strategies focused on interpersonal relationships as a tool to support physical health. Therapeutic practices that identify and leverage the strengths inherent in relationships build resilience against stress and improve overall physical health. Similarly, targeted interventions based on supporting effective relationships for individuals with chronic health concerns may support health prevention, potentially reducing hospitalizations and the need for medical interventions.

Additionally, by underscoring the crucial role of interpersonal relationships, healthcare providers may be more adept at providing holistic treatment. For example, prioritizing the practice of extensive visiting hours and active family/partner participation in daily life is crucial. Hospitals and in-patient care centers are forced to make tough decisions surrounding when and how the doors will be opened to loved ones, because of the inherent risks and challenges involved in letting individuals from the general public into tightly regulated buildings designated for healing. Inside hospitals, visiting hours are heavily regulated for safety concerns. Over time, literature has found significant benefits, including those related to safety in relation to having visitors in a hospital setting. In fact, existing literature has found that when intensive care unit (ICU) patients have a greater familial presence, they report an increased sense of safety[28].

4.2 Suggestions for Future Research

Notably, limitations to these findings do exist. While the measure used to assess relationship quality, the MSPSS, is an established and validated scale[22], ambiguous wording of relationship measure items may impact construct validity regarding the classification of relationship type. Specifically, the romantic relationships subscale includes statements like "There is a special person who is around when I am in need." Although this language intends to reference romantic relationships, it does not explicitly ask participants about their cur-

rent involvement with a steady or exclusive significant other. Additionally, the study's reliance on self-reported data to assess physical health is subjective. Biological markers such as cortisol samples, heart rates, or blood pressure to get an objective physical health measure would be more reliable and provide a more in-depth understanding of specific effects on direct physiological processes.

Moreover, we excluded participants reporting physical chronic disabilities or illnesses that greatly impacted general health and well-being on a day-to-day basis. Although this was intentionally done to improve the internal validity of our physical health measures and limit confounds, this exclusion limits the applicability of our findings to a broader population. Future research should consider including a more diverse sample to enhance the generalizability of the results to those with chronic health problems.

Future research might also examine the role of attachment styles within romantic relationships; specifically, how the difference in secure to insecure attachment in relationships moderates the extent of buffering effects. Attachment theory suggests that individuals with secure attachment styles experience more stable and supportive relationships, thus suggesting that attachment style moderates the buffering effect of relationships on the stress-health axis such that secure attachment provides a higher degree of buffering [29]. Similarly, future research may also include an analysis of features of romantic relationships (e.g., physical touch, quality time, sense of commitment, etc.) and how they contribute to these findings [30].

Also, future research may include further analysis of the role of demographic factors. The present sample had a mean age of 38, which likely encompasses many individuals in long-term monogamous relationships or marriages. Literature notes that long-term monogamous relationships do play a role in outcomes including perceptions of life satisfaction [31], which may be related to health. To better understand how generalizable the findings are and reduce covariates of relationship status, future research may explore differences in moderation effects within age groups to identify whether the buffering effects of relationship quality vary across different life stages or relationship statuses.

4.3 Conclusion

The present research highlights the crucial role of the presence of high-quality interpersonal relationships in people's lives, particularly ones that are romantic in nature, in mitigating the detrimental effects that stress can have on physical health. By demonstrating that romantic relationships can act as a significant buffer against stress, especially in conditions of high stress, our results underscore the importance of relationship-focused therapeutic strategies to enhance physical health outcomes. This research not only contributes to a deeper understanding within the broader scientific and psychological community of human stress resilience, but it also offers actionable insights that can be applied to clinical psychology and healthcare practices.

This work paves the way for future studies to further examine these relationships and refine interventions, leading to improved effectiveness and specialization of treatments for health and resilience in a diverse range of populations.

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7 EDITOR'S NOTES

This article was peer-reviewed.

REFERENCES

[1] Bethune, S. Stress in america 2022. *American Psychological Association* (2022). URL https://www.apa.org/news/press/releases/stress/2022/concerned-future-inflation.

[2] Basu, A., McLaughlin, K. A., Misra, S. & Koenen, K. C. Childhood maltreatment and health impact: The examples of cardiovascular disease and type 2 diabetes mellitus in adults. *Clinical Psychology: Science and Practice* **24**, 125–139 (2017).

[3] Schneiderman, N., Ironson, G. & Siegel, S. D. Stress and health: Psychological, behavioral, and biological determinants. *Annual Review of Clinical Psychology* **1**, 607–628 (2008).

[4] Shaw, J. A. Children exposed to war/terrorism.

Clinical Child and Family Psychology Review **6**, 237–246 (2003).

[5] O'Connor, D. B., Thayer, J. F. & Vedhara, K. Stress and health: A review of psychobiological processes. *Annual Review of Psychology* **72**, 663–688 (2021).

[6] DeLongis, A., Folkman, S. & Lazarus, R. S. The impact of daily stress on health and mood: Psychological and social resources as mediators. *Journal of Personality and Social Psychology* **54**, 486–495 (1988).

[7] Nabi, H. *et al.* Increased risk of coronary heart disease among individuals reporting adverse impact of stress on their health: the whitehall ii prospective cohort study. *European Heart Journal* **34**, 2697–2705 (2013).

[8] Pandey, A. K. *et al.* Impact of stress on female reproductive health disorders: Possible beneficial effects of shatavari (asparagus racemosus). *Biomedicine & Pharmacotherapy* **103**, 46–49 (2018).

[9] Ebbesen, S. *et al.* Stressful life events are associated with a poor in-vitro fertilization (ivf) outcome: a prospective study. *Human Reproduction* **24**, 2173–2182 (2009).

[10] Cohen, S. Social relationships and health. *American Psychologist* **59**, 676–684 (2004).

[11] Thoits, P. A. Social support as coping assistance. *Journal of Consulting and Clinical Psychology* **54**, 416–423 (1986).

[12] Baqutayan, S. Stress and social support. *Indian Journal of Psychological Medicine* **33**, 29–34 (2021).

[13] Tay, L., Tan, K., Diener, E. & Gonzalez, E. Social relations, health behaviors, and health outcomes: A survey and synthesis. *Applied Psychology: Health and Well-Being* **5**, 28–78 (2013).

[14] Bourassa, K. J., Ruiz, J. M. & Sbarra, D. A. The impact of physical proximity and attachment working models on cardiovascular reactivity: Comparing mental activation and romantic partner presence. *Psychophysiology* **56** (2019).

[15] Leschak, C. J. & Eisenberger, N. I. Two distinct immune pathways linking social relationships with health: Inflammatory and antiviral processes. *Psychosomatic Medicine* **81**, 711–719 (2019).

[16] Khledian, M. The relationship between attachment lifestyle with depression, hopefulness and emotional intelligence. *Open Journal of Social Science Research* **1**, 15 (2013).

[17] Hauser, D. J. *et al.* Evaluating cloudresearch's approved group as a solution for problematic data quality on mturk. *Behavior Research Methods* **55**, 3953–3964 (2022).

[18] Litman, L., Robinson, J. & Abberbock, T. Turkprime.com: A versatile crowdsourcing data acquisition platform for the behavioral sciences. *Behavior Research Methods* **49**, 433–442 (2017).

[19] Litman, L. & Robinson, J. *Conducting online research on Amazon mechanical turk and beyond* (SAGE Publications, 2020), 1st edn.

[20] Faul, F., Erdfelder, E., Buchner, A. & Lang, A.-G. Statistical power analyses using g*power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods* **41**, 1149–1160 (2009).

[21] Cohen, S., Kamarck, T. & Mermelstein, R. A global measure of perceived stress. *Journal of Health and Social Behavior* **24**, 385–396 (1983).

[22] Zimet, G. D., Dahlem, N. W., Zimet, S. G. & Farley, G. K. Multidimensional scale of perceived social support (mspss). *PsycTESTS* (1988).

[23] Ware, J. E. & Sherbourne, C. D. The mos 36-item short-form health survey (sf-36). i. conceptual framework and item selection. *Medical Care* **30**, 473–483 (1992).

[24] Hayes, A. F. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. *The Guilford Press* (2022).

[25] Norton, T. R. *et al.* Ovarian cancer patients' psychological distress: The role of physical impairment, perceived unsupportive family and friend behaviors, perceived control, and self-esteem. *Health Psychology* **24**, 143–152 (2005).

[26] Cohen, S., Janicki-Deverts, D., Turner, R. B. & Doyle, W. J. Does hugging provide stress-buffering social support? a study of susceptibility to upper respiratory infection and illness. *Psychological Science* **26**, 135–147 (2015).

[27] Southwick, S. M., Bonanno, G. A., Masten, A. S., Panter-Brick, C. & Yehuda, R. Resilience definitions, theory, and challenges: interdisciplinary perspectives. *European Journal of Psychotraumatology* **5** (2014).

[28] Jennifer L. McAdam, K. P. Symptoms experienced by family members of patients in intensive care units. *American Journal of Critical Care* **18**, 200–209 (2009).

[29] Collins, N. L. & Read, S. J. Adult attachment, working models, and relationship quality in dating couples. *Journal of Personality and Social Psychology* **58**, 644–663 (1990).

[30] Mosier, W. The essential elements of a healthy relationship. (relationships). *KSA Media* **6** (2003).

[31] Levenson, R. W., Carstensen, L. L. & Gottman, J. M. Long-term marriage: Age, gender, and satisfaction. *Psychology and Aging* **8**, 301–313 (1993).

[32] Average annual sunshine by city. *Current Results* (2024). URL https://www.currentresults.com/Weather/US/average-annual-sunshine-by-city.php.

[33] Bakolis, I. *et al.* Mental health consequences of urban air pollution: prospective population-based

longitudinal survey. *Social Psychiatry and Psychiatric Epidemiology* **56**, 1587–1599 (2021).

Appendix A

Supplemental Analysis

The Impact of Sun Exposure on Stress and Physical Health

We conducted an exploratory analysis to investigate the potential buffering effects of exposure to sunlight on the relationship between stress and health. Sun exposure was operationalized with the Sunny Days Per Year Index, a count of the total number of days in a year with less than 30% cloud cover in that city or town[32].

All participants who were eligible for inclusion in the main portion of the study were eligible for inclusion in the exploratory analysis. However, an additional 51 participants were excluded due to failure to report the city they were from, or due to residing in a town without adequate online data about weather trends. After exclusions, this analysis included 91 participants whose cities had adequate data on Sunny Days Per Year.

A moderation analysis was conducted in which physical health was regressed onto stress, sunny days per year, and their interaction. All constructs listed were mean-centered before calculating the interaction term. The overall model was positive and significant, $F(3, 87) = 3.12$ $p = .03$, however, there was no main effect of Sunny Days Per Year, $b = 0.00$, $t(87) = 0.17$, 95% CI [-0.04, 0.05], $p = .866$, no significant main effect of stress, $b = -0.24$, $t(87) = -0.78$, 95% CI [-0.83, 0.36], $p = .435$, and no interaction between Sunny Days Per Year and stress, $b = -0.00$, $t(87) = -0.19$, 95% CI [-0.00, 0.00], $p = .852$.

This exploratory analysis was done to address potential correlations between stress, health, and sun exposure, however, no significant findings were observed. It is possible that this resulted from confounding environmental factors, such as air quality[33], or low-quality data and measurement.

Appendix B

Perceived Stress Scale (Modified)

For each question choose from the following options:
Frequency: 0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, 4 = very often
Intensity: 0 = not severe, 1 = mildly severe, 2 = moderately severe, 3 = severe, 4 = very severe

1. In the last month, how often have you been upset because of something that happened unexpectedly?
   (a) How intense was this?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
   (a) How intense was this?
3. In the last month, how often have you felt nervous and stressed?
   (a) How intense was this?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
   (a) How intense was this?
5. In the last month, how often have you felt that things were going your way?
   (a) How intense was this?
6. In the last month, how often have you found that you could not cope with all the things you had to do?
   (a) How intense was this?
7. In the last month, how often have you been able to control irritations in your life?
   (a) How intense was this?
8. In the last month, how often have you felt that you were on top of things?
   (a) How intense was this?
9. In the last month, how often have you been angered because of things that happened that were outside of your control?
   (a) How intense was this?
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
    (a) How intense was this?

Appendix C

Multidimensional Scale of Perceived Social Support

For each statement choose from the following options:

Options: 1 = very strongly disagree, 2 = strongly disagree, 3 = mildly disagree, 4 = neutral, 5 = mildly agree, 6 = strongly agree, 7 = very strongly agree.

1. There is a special person who is around when I am in need
2. There is a special person with whom I can share joys and sorrows.

3. My family really tries to help me
4. I get the emotional help & support I need from my family
5. I have a special person who is a real source of comfort to me.
6. My friends really try to help me
7. I can count on my friends when things go wrong
8. I can talk about my problems with my family
9. I have friends with whom I can share my joys and sorrows
10. There is a special person in my life who cares about my feelings
11. My family is willing to help me make decisions

Appendix D

36-Item Short Form Health Survey (Modified)

1. In general, would you say your health is:
   (options: excellent, very good, good, fair, poor)
2. Compared to one year ago, how would you rate your health in general now?
   (options: much better, somewhat better, about the same, somewhat worse, much worse)
3. The following items are about activities you might do during a typical day. How does your health now limit you in these activities? If so, how much?
   (options: limited a lot, limited a little, not limited at all)
   (a) vigorous activities such as running, lifting heavy objects, and participating in strenuous sports
   (b) moderate activities such as moving a table, pushing a vacuum cleaner, bowling, or playing golf
   (c) lifting or carrying groceries
   (d) climbing several flights of stairs
   (e) climbing one flight of stairs
   (f) bending, kneeling, or stooping
   (g) walking more than a mile
   (h) walking several blocks
   (i) walking one block
   (j) bathing or dressing myself
4. In the past 4 weeks, have you had any problems with your work or other regular daily activities as a result of your physical health? (options: yes, no)
   (a) cut down the amount of time you spent on work or other activities
   (b) accomplished less than you would like
   (c) were limited in the kind of work or other activities
   (d) had difficulty performing the work or other activities
5. During the past four weeks, how often has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?
   (options: not at all, slightly, moderately, quite a bit, extremely)
6. How much bodily pain have you had in the past four weeks?
   (options: none, very mild, mild, moderate, severe, very severe)
7. During the past 4 weeks, how much did pain interfere with your normal work (including both your work outside the home and housework)
   (options: not at all, a little bit, moderately, quite a bit, extremely)
8. How true or false are the following statements to you?
   (options: definitely true, mostly true, don't know, mostly false, definitely false)
   (a) I seem to get sick a little easier than other people
   (b) I am as healthy as anybody I know
   (c) I expect my health to get worse
   (d) My health is excellent