Examining Social Support Buffering in a Serial Mediation Model relating Stress to Depressive Symptoms

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Abstract

A body of evidence supports the role of social support as a buffer against stress in the development of depressive symptoms. However, there are several conceptualisations and measures of stress and their relationships to depression and social support are complex. Here, we tested a serial mediation model between measures of stress and depressive symptoms in 94 university students (Study 1) and 335 mothers from a longitudinal cohort (Study 2). In both cohorts, significant serial mediation effects are observed, linking the number and impact of negative life events, current distress, recent perceived stress, and depressive symptoms. Social support buffered the development of depressive symptoms in response to perceived stress and not at other points in the mediation model. In Study 1, we found a significant moderating effect of perceived social support from friends and significant others, on the relationship between recent perceived stress and depressive symptoms. In Study 2, perceived social support from family and significant others moderated the link between perceived stress and depressive symptoms, and the stress from positive life events was also buffered by social support. By delineating the buffering role of social support against perceived stress, we hope our findings can inform social interventions for mental health.

Introduction

Life stress, in particular the occurrence of negative life events, is an established risk factor for depression across a diverse range of demographics from older adults to young adolescents and across genders, as seen in mothers and fathers. The severity of depression has been shown to vary with the amount of negative life change experienced by the individual. Another study found the timing and intensity of negative life events to be associated with current depressive symptoms among nonclinical adolescents in Japan. Together, these studies indicate that stressful life events are a robust predictor of depressive symptoms.

Yet, most people who experience stressful life events do not necessarily go on to develop depression. For example, only some individuals who experience the loss of a significant other subsequently develop depression, and this heterogeneity has been observed across the spectrum of negative life events. Social support has been identified as one of the most important protective factors against stressful life events in the development of depressive symptoms. The stress-buffering model proposes that social support protects against depressive symptoms by moderating the effects of stress on depression. One study found that social support attenuated the effect of stressful life events on depressive symptoms. Additionally, the impact of recent perceived stress on depressive symptoms was found to be reduced in undergraduate students with high social support relative to those with low social support. In a study involving subclinical adolescents, peers' social support had buffered adolescents against worsening depressive symptoms following the occurrence of negative events. The role of social support in alleviating depressive symptoms has also been examined among older adults. For instance, low social support and low socioeconomic status was observed to significantly increase the odds of depressive
symptoms among the elderly population in Singapore\textsuperscript{15}. Moreover, a systematic review demonstrated the protective role of social support against depression among community-dwelling older adults in Asia\textsuperscript{16}. This evidence strongly suggests that social support interacts with life events in influencing depressive symptoms.

However, other studies found that social support does not always moderate the relationship between negative life events and depressive symptoms. A study involving postnatal mothers reported that while social support was able to protect against postpartum depression, it did not buffer against the effects of other stressors\textsuperscript{17}. Similarly, a study examining the link between current distress from lifetime exposure to stressful events and depressive symptoms in emerging adults found that neither perceived nor received social support moderated this relationship\textsuperscript{18}.

An important difference among these studies was how stress was conceptualized and measured. In some studies that did not find a significant moderating effect of social support, stress was measured based on the presence or absence of a single life event or type of stressor, such as a nuclear accident\textsuperscript{19}, or childbearing or rearing stressors\textsuperscript{17}. Other studies that did not find a significant stress-buffering effect looked at a wider range of life events, and conceptualized stress to be the current distress related to life events\textsuperscript{18}. These conceptualisations of stress differ from other studies that have found a significant moderating effect of social support, which examined a more general range of life events and the number of life events\textsuperscript{14}, perceived stressfulness of life events at the time they occurred\textsuperscript{12} and recent perceived stress\textsuperscript{13} as predictors. Based on these differences, we postulate that how stress is conceptualised and measured could contribute to whether social support was observed to have a buffering effect in a given study.

Another potential reason for the heterogeneity may be the different demographic profiles of the individuals. It is noted that the lack of moderation effect is more commonly reported among mothers\textsuperscript{17,19–22}). A previous study suggested that social support, though directly protective against depression, was likely insufficient to ameliorate the negative effects of financial, parenting and health-related stress\textsuperscript{21}. Another study pointed out that becoming a mother may change a woman’s needs in social interactions from those that are typical of earlier life stages\textsuperscript{22}. Thus, it remains unclear in what ways and types of social support protect mothers from their depressive symptoms.

Taken together, there is a need to further clarify the reasons for the mixed findings in the literature and investigate more closely the buffering mechanisms of social support in the different demographic contexts. We first sought to understand the relationships between measures of life events and stress, and their direct and indirect effects on depressive symptoms. We hypothesised that there is a chain of causality from the occurrence of negative life events to their perceived impacts to the experience of stress to depressive symptoms. We used this model to test the role of social support as a buffer at different points, and examined how this varies with the demographics of the receiver and the relationship type with the giver. We examined these models first in a population of university students in Singapore.
(Study 1) and second in a cohort of Singapore mothers (Study 2) to examine the effect of demographic context.

**Results**

**Study 1**

The descriptive statistics and univariate analysis of variance of gender, ethnicity and highest qualification level on depressive symptoms are reported in Supplementary S3.

**Serial mediation model**

There was a significant total effect ($c = 1.635$, 95% CI [0.424, 2.846], $se = 0.610$) of the number of life events on depressive symptoms (Fig. 1). There was a significant serial mediation where the occurrence of negative life events was associated with greater current distress due to life events which in turn was associated with increased perceived stress, which was associated with increased depressive symptoms ($indirect\ effect = 1.902$, 95% CI [0.493, 3.475], $se = 0.757$). The direct effect and other mediations were not significant (Supplementary S4).

![FIGURE 1]

**Moderated mediation models**

Within the serial mediation model, perceived social support moderated the link between recent perceived stress and depression, and not the other predictors (Supplementary S5). Moderated mediation was significant with an index of moderated mediation to be -0.622 (95% CI [-1.656, -0.107], $se = 0.398$). This suggests that the serial mediating effect was moderated by the levels of social support of the participant. Specifically, the conditional indirect effect was the strongest in those with low perceived social support (one SD below the mean), $b = 2.525$, 95%CI [0.638, 5.289], $se = 1.183$ and the weakest in those with high perceived social support (one SD above the mean), $b = 1.313$, 95%CI [0.281, 2.551], $se = 0.575$. See Fig. 2 for the moderated mediation model.

![FIGURE 2]

There was a stronger positive association between recent perceived stress and depression for participants with low levels of perceived social support (one SD below the mean), $b = 1.366$, 95% CI [0.865, 1.866], $se = 0.252$, $p < .001$, relative to those with high levels of perceived social support (one SD above the mean), $b = 0.710$, 95% CI [0.301, 1.119], $se = 0.206$, $p < .001$. The interaction plot also showed a buffering effect in which the positive relationship between perceived stress and depressive symptomatology became weaker as perceived social support increased (Fig. 3). Participants with low social support and high perceived stress exhibited the worst depressive symptoms.
Positive life events

We investigated if this mediation model was applicable to any type of life event, negative and positive. There was no significant moderated mediation effect for positive life events with the index to be -1.541 (95% CI [-11.103, 0.015], se = 2.831).

Subtypes of perceived social support

We replicated the analysis with the different subtypes of social support - social support from friends, family and special persons. There was significant moderated mediation of -1.833 (95% CI [-3.483, -0.400], se = 0.789) for social support from friends and – 0.326 (95% CI [-1.366, −.033], se = 0.357) from a special person. However, there was no significant moderated mediation for social support from family.

Study 2

Descriptive and correlation analysis

All descriptive statistics and univariate regression were reported in Supplementary S8.

Serial mediation model

Results showed that there was a significant total effect (c = 0.198, 95% CI [0.042, 0.355], se = 0.080) of the number of life events on depressive symptoms. The indirect effect of the number of life events through current distress due to life events then through recent perceived stress was not significant. The direct effect and other indirect effects were not significant (Supplementary S9).

Due to high collinearity between the number of negative life events and negative impact of life events $r(325) = .94, p < .001$, we conducted a simple mediation model to observe if the collinearity between the two factors had affected our results. When the impact of negative life events was excluded from the model, the results showed that the indirect effects of the number of negative life events through perceived stress on depressive symptoms was significant (indirect effect = 0.115, 95% CI [0.053, 0.334], se = .072). When running the model without the number of negative life events, the results showed that the indirect effects of the impact of negative life events through perceived stress on depressive symptoms was significant (indirect effect = 0.061, 95% CI [0.026, 0.216], se = .048). The collinearity between the variables could explain the lack of significance of the serial mediation effect.

Moderated mediation models

Moderated mediation models with perceived social support moderating the links between recent perceived stress and depressive symptoms were tested. There were significant moderated mediation effects where the link between perceived stress and depressive symptoms were moderated by social support (see Figs. 4 and 5).
With the number of negative life events as the predictor, the moderated mediation model (bootstrap = 10,000) was significant with an index of moderation mediation to be $-0.066$, 95% CI $[-0.226, -0.006]$, $se = 0.057$.

[FIGURE 4]

With the impact of negative life events as the predictor, the moderated mediation model (bootstrap = 10,000) was significant with an index of moderation mediation to be $-0.035$, (95% CI $[-0.145, -0.003]$, $se = 0.037$).

[FIGURE 5]

A sensitivity analysis with potential covariate variables was conducted to check the robustness of the model. Preliminary analyses showed that there were differences in depressive symptoms among the varying education levels and household income groups. As such, the moderated mediation model was repeated with education level and household income as covariates. Similarly, there was a significant mediational effect and moderation effect by perceived social support. However, no significant moderated mediation was observed (see detailed results in Supplementary S10).

Positive life events

Positive life events were associated with greater stress and depression. Social support still buffered against depression in the presence of stress (see detailed results in Supplementary S11).

Subtypes of perceived social support

We replicated the analysis with the different subtypes of social support. When the number of negative life events was the predictor, moderated mediation for social support from family, $-0.052$ (95% CI $[-0.166, -0.004]$, $se = 0.042$) and for social support from a special person, $-0.054$ (95% CI $[-1.913, -0.0007]$, $se = 0.050$) were significant, and not for social support from friends. When the impact of life events was the predictor, moderated mediation for social support from family, $-0.027$ (95% CI $[-0.107, -0.002]$, $se = 0.027$) and from a special person, $-0.028$ (95% CI $[-0.1239, -0.0005]$, $se = 0.033$) were significant, and not for social support from friends.

Discussion

The two studies lend support for a model where perceived stress mediates the association of negative life events with more severe depressive symptoms. This aligns with a previous meta-analysis$^{11}$ and supported by other studies focusing on the link between life events and depressive symptoms in students$^{7}$, emerging adults$^{18}$ and the maternal population$^{17}$. Additionally, negative life events, specifically family and social problems, were observed to be directly associated with levels of perceived stress$^{24}$.  

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The university population showed a serial mediation from the occurrence of negative life events to their perceived impact on current mood to perceived stress to depressive symptoms, however in mothers from the Growing Up in Singapore Towards healthy Outcomes (GUSTO) study, occurrence and impact each were mediated by perceived stress, but occurrence was not mediated by impact. This might be explained by the high collinearity between occurrence and impact of negative life events in the GUSTO mothers ($r = .94$), differences between impact on current mood in study 1 instead of perceived impact of the life event in study 2 or differences between populations in specific cognitive vulnerabilities\textsuperscript{25}. Previous research found that ruminative thinking and worry due to stressful life events led to increased depressive symptoms in young adolescents\textsuperscript{4}. Moreover, depressive symptoms have been associated with chronic strain related to negative life events among mothers\textsuperscript{22}.

Social support was consistently protective against depressive symptoms among participants with higher levels of stress across both studies. This is once again consistent with the findings of previous studies\textsuperscript{26}. In high stress, when an individual's capacity to manage independently is exceeded, social support may become critical to raise their ability to cope\textsuperscript{13}. Notably, we found that social support only moderated the association between perceived stress and depressive symptoms, suggesting a 'late buffering' effect in our mediation model. Social support showed no moderation of the association between the occurrence and impact of negative events, and no associations between negative life events and perceived stress. This may indicate that social support buffers the affective impact of stress that one perceives from a life event. Specifically, an individual with high social support may still perceive and experience the same level of stress from an adverse life event, but is able to handle the consequences of such stress and regulate their emotions, or may be less prone to depressive cognitions such as helplessness and personalisation\textsuperscript{27,28}.

In the study 1 university population, there was only a buffering effect from the social support of friends and significant others; however, in the study 2 mothers, there was only a buffering effect from the social support of family and significant others. Youth have been shown to seek out peers rather than family for social support reflecting a developmental focus on intimacy\textsuperscript{29}, while mothers may be more satisfied with support from their parents than support from their friends when experiencing struggles in parenting\textsuperscript{30,31}. In Singapore, instrumental support often from grandparents and perceived conflicts with relatives have been shown to predict perinatal depression\textsuperscript{32}. Studies involving mothers that returned no significant moderating effects tended to combine the scores of social support from multiple sources, possibly due to the dilution of instrumental or familial support\textsuperscript{20–22}.

In terms of strengths, our studies provide a comparison of the stress-buffering effect of social support between two Singapore populations. Furthermore, the moderated mediation finding where social support buffers against depression in the presence of high stress was replicated across both studies, despite substantive differences in life stages and likely stressors between populations. Additionally, the demographic fills an important gap as other Singapore studies on social support in depression has focused on the elderly population\textsuperscript{33,34}, although the youth age group of 18 to 34 years comprised the
majority of depression cases in the local context\textsuperscript{35}. In terms of limitations, in study 1, life events were recalled retrospectively at the same time as depressive symptoms, while in study 2, depressive symptoms were examined 1.5 years after the measurement of stressful life events over a one-year period. This supports a temporality of stressors preceding depression, but would be better supported with repeated measures over time. Some of the differences in measures, timepoints and populations may add complexity when comparing between studies.

The results of the present study have important practical implications. By understanding how stressful life events are related to depression and the pathway by which such events influence depressive symptoms, self-report measures of stressful life events and perceived stress may be used as a proxy to identify people who are at risk of depression, and offer preventative resources to reduce their likelihood of developing clinical depression. By adding clarity to how social support buffers against depression and which forms of social support are important in which populations, our study may inform the application of social support-based interventions\textsuperscript{36}. Our findings support existing literature highlighting the stress-buffering role of social support in alleviating the adverse effects of stress, during stressful periods such as COVID-19\textsuperscript{37}, and pregnancy\textsuperscript{38}.

Furthermore, by examining the exact locus of the buffering effect social support on life events and depression, researchers and clinicians may provide more targeted advice to caregivers of those who are significantly emotionally impacted by life events. For example, social support was found to moderate the relationship between perceived stress and depression at an earlier stage in the pathway, which may imply that social support might be better for coping with stress arising from life events. Additionally, given the differing locus of the stress-buffering effect of social support found in our studies, there could be more nuances in evaluating individuals’ vulnerability to depression and the designing of the interventions with clients. For instance, mothers might want to assess how family members support them, and how their family members can be involved in the therapy trajectory. For youth, they might want to assess the social support among peers and romantic partners and work towards expanding social support among similarly aged individuals.

In summary, our study offers nuanced insights into the relationship between negative life events, perceived stress, and social support, and their impact on depressive symptoms across different populations in Singapore. Our findings emphasise the stress-buffering role of social support in alleviating depressive symptoms, particularly during periods of heightened stress. The differential impact of social support in both studies emphasise the need for tailored interventions that consider unique social support preferences in various demographic contexts. Finally, our findings contribute to a more complex understanding of an individual's vulnerability to depression, which may have practical implications in the development of effective and personalized mental health interventions for diverse populations.

\textbf{Methods}
Study 1

Participants

Participants (N = 94) consisted of 62 females and 32 males, recruited via word-of-mouth and from the National University of Singapore. The mean age of participants was 23.46 years (SD = 1.44) and ranged between 20 and 27 years. Participants were predominantly Chinese, and Singapore citizens (refer to Supplementary Table S1). The inclusion criteria for participants were individuals aged 18 and above with no current diagnosis of depression. The study received ethical approval in accordance with the Declaration of Helsinki. Informed written consent was obtained from participants during study recruitment.

Measures

Demographic characteristics were gathered: age, gender, ethnicity, nationality, highest education level, household income. The number and impact of life events was assessed with the Life Events Scale (LES)\(^{39}\). Participants indicated whether an event has happened in their life and rated their perceived impact on the current mood of any applicable events from negative to positive ratings. Global perceived stress was measured using the Perceived Stress Scale\(^{40}\). Perceived social support from family, friends and a significant other, was measured by The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, et al., 1988). Depressive symptomatology was measured using the Inventory of Depressive Symptomatology Self Report (IDS-SR)\(^{41}\) scale. Details of the measures are found in Supplementary S2.

Procedure

Participants completed the online cross-sectional questionnaire administered via Qualtrics.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics Version 25. The .05 level of significance was used in all statistical tests. Descriptive and correlation analyses were first performed on the variables. Preliminary analyses include descriptive analyses, correlation analyses and univariate regressions examining the association between demographic characteristics and depressive symptoms and recent stress.

Various models in PROCESS macro for SPSS\(^{23}\) were used. To test our hypothesis on a causal chain linking the mediators (current cumulative impact due to life events and recent perceived stress) with a
specified direction flow, we ran a serial mediation model using Model 6. The mediation model was tested using a bootstrapping approach (bootstrap = 10,000) to assess the significance of the indirect effects. We then examined more closely the moderation effect of social support at the various links of the mediation model which included: (i) the number of life events and the impact of life events using Model 83; (ii) the impact of life events and the recent perceived social support using Model 91 and (iii) the recent perceived stress and depressive symptoms using Model 87. The variables entered were similar, except that perceived social support was also entered as the moderating variable.

We also conducted secondary analyses, examining the models with positive life events and various subtypes of social support (i.e., social support from friends, family and a significant other). We replicated all above analyses, with the number of positive life events and impact of positive life events, in replacement of negative life events variables. Finally, the analyses were replicated with the different subtypes of perceived social support.

**Study 2**

Study 2 was conducted to test the reproducibility and generalisability of the serial mediation model and moderation by social support observed in Study 1 to the mothers' population.

**Participants**

The participant data was taken from the GUSTO study (Soh et al. 2014), which is a mother-offspring prospective cohort study (N = 327). The mean age of participants was 38.7 years (SD = 1.45) and ranged between 30 and 41 years. The breakdown of the ethnicities, education levels, household income, accommodation type of the participants can be seen in Supplementary Table S6.

**Measures**

Demographic characteristics were measured: age, ethnicity, highest education level, household income, and accommodation. The number and impact of life events was assessed with the Life Experience Survey. Participants indicated whether this event has happened to them in the past year and rated their perceived impact of those events on their life at the time of occurrence. Depressive symptomatology was measured using Beck's Depression Inventory (BDI). Recent perceived stress and perceived social support were measured with the same scales in Study 1. Details of the measures are found in the Supplementary S7.

**Procedure**
Participants completed a set of questionnaires at different timepoints after giving birth. When the child was at the age of 7 years, mother’s life events, recent perceived stress and perceived social support were measured. When the child was 8.5 years old, depressive symptoms of the mothers were assessed.

**Statistical analysis**

We replicated the same serial mediation analysis conducted in study 1. Additionally, we conducted two simple mediation models using Model 4, with the criterion variable being depressive symptoms, recent perceived stress as mediating variable and the predictor variable being the number of negative life events or the negative impact of life events. To examine the moderation effect of social support at the same link that was found to be significant in study 1, we run moderated mediation models using Model 14. Perceived social support was entered as the moderating variable between the links of perceived stress and depressive symptoms. Similar secondary analyses were conducted as study 1.

**Declarations**

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Author’s Contributions

FT: Analysis and writing. ROJM: Writing and manuscript preparation. KJL, LXY: Data collection and analysis. SL: Analysis and writing. NR: Data collection and manuscript preparation. SHL, NH: Manuscript preparation. HC, MM: GUSTO data collection. GCYT: Conceptualisation, supervision of data collection, supervision of analysis, and writing.

**Data Availability Statement**

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

**Additional Information**

*Competing Interests*

The author(s) declare no competing interests.
References


Figures
Figure 1

The serial mediating effect of the current cumulative impact due to life events and recent perceived stress in the relationship between the number of negative life events and depression. *p < .05, **p < .01, #p < .001; All presented effects are unstandardized; $a_1$ is the effect of the number of life events on mediators; $b_1$ is the effect of mediators on depression; $c'$ is the direct effect of the number of life events on depression; $c$ is the total effect of the number of events on depression; $d$ is the effect of current cumulative impact due to life events on recent perceived stress.

Figure 2

The moderated mediation effect of the perceived social support between recent perceived stress and depression. *p < .05, **p < .01, #p < .001; All presented effects are unstandardized; $a$ is the effect of the number of life events on current cumulative impact due to life events; $b$ is the effect of current distress
due to life events on recent perceived stress, \( c_n \) is the effect of recent perceived stress on depression at different levels of perceived social support.

**Figure 3**

The interaction plot of the moderation effect of perceived social support on the relationship between perceived stress and depression.
Conditional moderated mediation (Model 14) with the number of life events predicting perceived stress with a significant interaction between perceived stress and social support, while controlling for parental care and overprotection. *p<.05, **p<.01, ***p<.001.

Moderated mediation = -0.066, 95CI[-.229, -0.006], se = .0574
**Figure 5**

Conditional moderated mediation (Model 14) with the impact of life events predicting perceived stress with a significant interaction between perceived stress and social support while controlling for parental care and overprotection. \( *p < .05, \quad p^{**} < .01, \quad ***p < .001 \).

**Supplementary Files**

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