



Research article

Role of self-esteem and personal mastery on the association between social support and resilience among COVID-19 long haulers

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ABSTRACT

Although the COVID-19 mortality rate is declining, the number of individuals dealing with persistent COVID-19 symptoms is increasing worldwide, making long COVID a global public health concern. People with long COVID (long haulers) often deal with physical and mental stressors. Long haulers' psychological resilience could play a key role in coping with these stressors in intercorrelation with psychosocial resources. The current study aims to test a hypothesized relationship between social support and its functions (i.e., instrumental and emotional) and the resilience of long haulers through serial mediation by personal mastery and self-esteem. A cross-sectional and self-administered online survey was conducted among 460 individuals with long COVID recruited from COVID-19 Facebook support groups in the United States. Analyzing data indicated a positive correlation between social support and the resilience of long haulers. Structural equation modeling suggested that self-esteem and personal mastery fully mediated the association between social (instrumental) support and resilience. Personal mastery also mediated the association between self-esteem and resilience in social (instrumental) support models. However, in the emotional support model, the indirect effect was non-significant for the mediation by personal mastery and self-esteem. Findings suggest that social support, mainly instrumental support, may protect long haulers by promoting their resilience through self-esteem and personal mastery. This study emphasizes the importance of including social support services in designing programs for COVID-19 long haulers.

1. Introduction

As of October 2023, there have been over 770 million confirmed cases of COVID-19, including about 7 million deaths, reported to WHO [1]. To date, COVID-19 remains a mysterious pandemic with emerging post-infection complications. Though many recover within a month, some face prolonged health issues, termed "Long-COVID-19". Guidelines classify COVID-19's progression into three phases: Acute (up to 4 weeks), ongoing symptomatic (4–12 weeks), and post-COVID-19 syndrome (beyond 12 weeks) [2–4]. "Chronic COVID" and "Protracted COVID" also describe these prolonged effects, though the exact nature and overlap with other post-viral

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syndromes remain uncertain [5]. A growing literature on COVID-19 reported long-term symptoms among people with coronavirus infection (long-haulers) [6]. Based on recent studies, 20–60 % of individuals infected with coronavirus deal with post-acute COVID-19 syndrome (PACS) [7–9]. While physical symptoms get the most attention, mental health issues are also frequently reported among long haulers [10–13]. Mental health issues in long haulers can be triggered by multiple stressors [14]. Previous studies have demonstrated that social stressors (e.g., isolation and disrupted routines) [15], economic stressors (e.g., getting laid off and difficulty accessing resources) [16], physical stressors (e.g., shortness of breath and fatigue) [17], and psychosocial stressors (e.g., anxiety, sadness, and loneliness) [17,18] could influence long haulers' well-being. In response to these stressors, psychological resilience could play a key role in coping with adverse outcomes related to long COVID.

Resilience refers to the ability of an individual, community, or system to adapt, recover, and overcome past or present stressors and adversities [19]. In the context of exposure to a significant psychological or environmental adversity, resilience is an individual's ability to seek and utilize resources that promote health and well-being. Simultaneously, it represents the capability of families, communities, and cultures to offer these health resources in ways that are culturally significant and relevant [20]. Resilience is a construct of a dynamic process of adaptation that can be facilitated by multiple intrapersonal and interpersonal resources [21]. Multiple studies demonstrated the beneficial effect of resilience interventions in enhancing adaptability toward stressful events such as illness [22,23] and pandemics [24]. Social support has been identified as a key interpersonal factor in maintaining and promoting individuals' psychological resilience against health crises and disasters [25–28]. However, how social support could affect the psychological resilience of long haulers has not been studied yet. Based on the literature, we hypothesized that in addition to the direct effects of social support on resilience, intrapersonal factors such as self-esteem and personal mastery could mediate the social support-resilience relationship in long haulers. Accordingly, a theoretical hypothesis model (see Fig. 1) was developed in which social support is positively associated with psychological resilience in long haulers, and self-esteem and personal mastery could mediate this relationship in a serial mediation fashion.

Following the COVID-19 pandemic, numerous researchers extensively investigated the physical and immediate psychological impacts of the pandemic on individuals [29–31]. However, as time progressed, another health crisis related to COVID-19 emerged, known as long COVID [4,32]. A meta-analysis estimating the combined prevalence of long COVID suggests a high prevalence (43 %) of individuals with long COVID among those who contract COVID-19 globally [33]. Recent research reveals that people with PASC endure prolonged, complex symptoms that significantly impact their quality of life and limit their ability to work [34] accompanied by a low level of resilience [35]. To enhance the quality of life and mental health of long haulers, their resilience might be a key factor, assisting them in more effectively coping with the symptoms of long COVID [36]. However, our understanding of the mechanisms that could improve the resilience of long haulers is limited. Particularly, the mechanism by which social support, a widely recognized resource for coping with stressful conditions and daily problems [37], contributes to the resilience of long haulers is not well understood. This manuscript aims to fill this knowledge gap by examining how social support interacts with individual psychological constructs such as self-esteem and personal mastery to influence resilience among long haulers. By focusing on these understudied areas, this study not only aims to broaden our understanding of the psychosocial impacts of long COVID-19 but also to inform more effective, holistic support and intervention strategies for individuals struggling with long-term post-COVID conditions.

1.1. Social support-resilience

Social support is understood as the resources available in an individual's environment for coping with stressful conditions and day-to-day problems [37]. As described by Cobb [38], social support is information that makes an individual feel: (1) loved and cared for; (2) respected and valued; and (3) part of a community with mutual communication and responsibilities. In other words, social support refers to an individual's social bonds, social integration, and primary group relations [39]. Prior research has demonstrated social support as one of the most significant external resources for coping and adjustment [40]. People perceiving adequate social support are more likely to exhibit higher levels of resilience partly due to better access to practical external resources to help them cope with stressors [27,41]. COVID-19 studies revealed that social support was crucial for promoting resilience and positive adaptation during

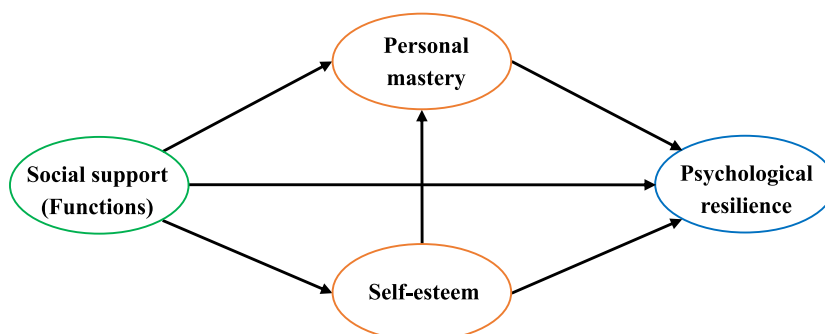


Fig. 1. Hypothesized model of social support impact on long haulers' psychological resilience.

the COVID-19 lockdown [42]. Consistent with attachment theory, which proposes that attachment figures, both directly and indirectly, modulate arousal and stress responses, an expanding body of empirical research indicates that robust social support is associated with enhanced stress-regulation behaviors [28]. Social support can improve our perception of managing challenges the pandemic poses and augment psychological adaptability [43]. Enhanced social support might amplify sensations of group cohesion and affiliation, foster adaptive coping strategies like physical activity, facilitate cognitive reframing of adverse circumstances to diminish perceived threats, and improve the modulation of emotions, including distrust, anxiety, and apprehension [28]. In a recent study by Galanis et al. [44], authors observed a notable positive correlation between resilience, social support, and quality of life among long haulers. Based on their findings, resilience and social support appear to serve as protective factors, diminishing mental health symptoms and enhancing the quality of life in long haulers.

H1. Social support from family, friends, communities, and organizations/institutions positively correlates with long haulers' psychological resilience.

1.2. Social support-self-esteem-resilience

As supported by Ungar's social ecological model of resilience [45] and previous studies [40,46–48], the association between social support and resilience could be mediated through intrapersonal psychological resources. Self-esteem is a primary intrapersonal psychological resource that could mediate the association of social support and resilience [40,49,50]. Self-esteem is conceptualized as the thoughts and feelings of individuals about their importance and value [51], which is formed through being evaluated as influential individuals by self and others. Self-esteem is the individual's assessment and consistent perception of themselves. It signifies whether they view themselves positively or negatively, and how much they consider themselves competent, important, successful, and valuable. Essentially, self-esteem is a person's sense of self-worth, as reflected in their self-view [52]. Empirical studies showed that social support positively correlates with self-esteem [53,54]. Social support can make people feel loved and trusted, essential to self-esteem development [49]. Previous studies suggested that individuals with a higher level of social support viewed themselves more positively and lived a more fulfilling life, which were the proxies of high self-esteem [55,56]. This positive influence of social support on self-esteem can further elevate individuals' resilience. High self-esteem has been considered a protective factor for resilience [49]. Individuals with high self-esteem exhibit more willingness to strive and persevere, allowing them to be more flexible and tolerant of changes in the face of obstacles and distress [49]. In line with Rutter's view, self-worth, feelings, and trust in personal competency can be helpful by supplying various protective resources and functions for personal growth in dealing with difficult situations [57]. As such, self-esteem, together with self-belief and hope, could significantly promote the resilience of individuals [58]. Self-esteem is perceived as a personal characteristic of the people who survive or even grow when confronting difficulties, which are essential attributes of resilience [59]. The positive association of self-esteem with resilience has been shown in various populations, such as homeless people [60], adolescents [61], injured adults [62], teachers [63], and university students [50] during COVID-19.

1.3. Social support-personal mastery-resilience

Personal mastery is another intrapersonal resource that could mediate the association of social support with resilience [64–67]. Personal mastery refers to how people feel in command of their lives [65]. Personal mastery refers to a comprehensive feeling of control, or the belief that one can influence upcoming significant life events [68]. Personal mastery empowers individuals to delve into their true aspirations, directing their energy towards developing both their personal and professional abilities and capacities [69]. Social support can enhance personal mastery by providing the material and psychological resources required to successfully complete daily tasks, especially in stressful conditions [70]. A study among women reported that more emotional support was associated with higher personal mastery [71]. Notably, this positive effect can extend to resilience. Personal mastery could promote individuals' perceptions of higher control over the situation and strengthen their problem-focused coping strategies [66,67], resulting in a higher level of resilience [72]. Clinical research has revealed that personal mastery, as a coping resource, was positively associated with patients' resilience, protecting them against declining well-being [73,74].

1.4. Interaction of self-esteem with personal mastery

Self-esteem is an important factor in formulating an individual's personal mastery [40,46]. Previous studies have demonstrated a positive relationship between self-esteem and personal mastery [40,75]. According to the self-enhancement perspective, providing social support may improve an individual's sense of purpose and self-esteem, which then helps them feel valued and useful [76,77]. Therefore, it is plausible that the influence of social support on resilience occurs through serial mediation by intercorrelated intrapersonal resources of self-esteem and personal mastery (see Fig. 1).

H2. Self-esteem and personal mastery mediate the relationship between social support and psychological resilience of long haulers in a serial mediation fashion.

2. Methods

2.1. Participants and procedure

A cross-sectional online survey was conducted among COVID-19 long haulers in the United States from January 13, 2022, to March 26, 2022. Eligibility criteria for participants included (1) being aged 18 years or older, (2) living in the United States, (3) Being able to understand English, and (4) having been infected with Covid-19 and experienced at least one symptom (e.g., respiratory and heart symptoms, long-lasting fatigue, neurological symptoms) after infection. Using a convenience sampling approach, participants were recruited from COVID-19 Facebook groups that were formed to discuss COVID-19-related topics. Specifically, these Facebook groups were searched and reached out online. After approval by their administrators, recruitment advertisements were posted, including a brief study description, the survey link, and a flyer on the Facebook pages. Participants could access the online survey as distributed through the Redcap survey platform. Participants were navigated to a self-administered survey after providing informed consent and prescreening for the inclusion criteria. The survey took about 20 min, and participants could withdraw anytime. Upon completion, participants could opt-in to a raffle-based incentive for a USD 30 gift card. To maintain participants' confidentiality, a number was assigned to survey responses for each participant, and no identifying information was collected. A total of 656 individuals responded to the invitations and participated in the survey, of which 196 were removed later due to non-completion or not meeting the inclusion criteria. Finally, data from 460 participants were included in the analysis. The study protocol was reviewed in accordance with 45 CFR 46.104(d) (2) and 45 CFR 46.111(a) (7) and received an exemption from Human Research Subject Regulations on May 4, 2021 by the University of South Carolina Institutional Review Board due to the minimal risks posed to participants (Pro00109939).

2.2. Measures

Social Support: We used an adapted Medical Outcomes Study Social Support Survey (mMOS-SS) version to measure social support [78]. The mMOS-SS scale includes 8 items that measure emotional support (3 items), instrumental support (4 items), and informational

Table 1
Demographic characteristics of COVID-19 long haulers (N = 460).

Characteristics	N (%)
Gender	
Male	231 (50.2 %)
Female	225 (48.9 %)
Nonbinary	4 (0.9 %)
Education level	
High school degree or equivalent	14 (3 %)
Some college, but no degree	94 (20.4 %)
Associates degree	60 (13 %)
Bachelor's degree	274 (59.6 %)
Post-graduate degree or above	18 (3.9 %)
Annual income	
< \$10,000	1 (0.2 %)
\$10,000 to \$24,999	26 (5.7 %)
\$25,000 to \$49,999	164 (35.7 %)
\$50,000 to \$100,000	258 (56.1 %)
>\$100,0000	11 (2.4 %)
Race/ethnicity	
Caucasian	322 (70 %)
African American	79 (17.2 %)
Hispanic/Latino	41 (8.9 %)
Asian	4 (0.9 %)
American Indian/Alaskan Native	10 (2.2 %)
Native Hawaiian/other Pacific Islanders	4 (0.9 %)
Hospitalization	
No	103 (22.4 %)
Yes	357 (77.6 %)
Pre-existing conditions	
No	366 (79.6 %)
Yes	94 (20.4 %)
	Mean (SD)
Age	31.97 (6.19)
Social support	25.28 (4.68)
Emotional support	9.39 (2.26)
Instrumental support	12.79 (2.78)
Resilience	19.14 (4.76)
Personal Mastery	17.38 (4.05)
Self-esteem	27.05 (4.36)

SD (standard deviation).

support (1 item). The example items are that participants were asked if they believed in having others who understood them (e.g., *someone who understands your problems*), provided support in times of need (e.g., *someone to help with daily chores if you were sick*), and made a good time with them (e.g., *someone to have a good time with*). Response choices ranged from “none of the time (1)” to “all of the time (5)” with possible sum scores ranging from 8 to 40 for social support, 3 to 15 for emotional support, and 4 to 20 for instrumental support. Higher sum scores mean higher levels of social support. The mMOS-SS scale was employed to measure social support in many populations, such as healthcare workers [79] and patients with chronic diseases during COVID-19 [80,81]. The mMOS-SS scale has been validated and showed reliable psychometric properties for multiple populations, such as elderly users of primary healthcare facilities, civil servants, elders with chronic diseases, and the general population [78,82–84]. Cronbach’s alpha for the social support scale was 0.61 in this study.

Resilience: To measure resilience, we employed an adapted version of the Connor-Davidson Resilience Scale (CD-RISC) (67). This scale has nine items with five response choices from “Not true at all (0)” to “True nearly all the time (4)”. The scale reflects the individual ability to endure experiences, such as change, illness, personal problems, pressure, painful feelings, and failure (e.g., “*I am able to adapt to change*”, “*I can achieve goals despite obstacles*”). The final score (range 0–36) was computed from the sum of the responses of each item, with higher scores representing higher resilience levels. The CD-RISC instrument is one of the most common scales of resilience in COVID-19 studies, including long COVID [85–87]. The CD-RISC instrument was validated and indicated reliable psychometric properties in different populations like young individuals [88], critical care nurses [89], patients [90], and general populations [91,92]. Cronbach’s alpha for the resilience scale was 0.58 in this study.

Self-esteem: We used the Rosenberg Self-Esteem Scale (RSES) (36) to measure self-esteem. It is the most widely used measure of self-esteem that depicts the global perception of the individual’s self-worth. It has been employed to measure self-esteem in various populations, including patients with chronic diseases [93]. It is a 10-item measure of self-esteem including half positively (e.g., “*I feel that I have a number of good qualities*”) and half negatively (e.g., “*I feel useless at times*”) worded items with the 4-point response format ranging from strongly disagree (1) to strongly agree (4). The sum scores were generated, with higher scores indicating higher self-esteem. Scores ranged from 10 to 40. The Rosenberg Self-Esteem Scale has been validated and showed reliable psychometric properties in a variety of populations, including students [94], individuals with intellectual disabilities [95], and the general population [96]. Cronbach’s Alpha for the self-esteem measure in this study was 0.64.

Personal mastery: We used a subscale of the Sense of Control Scale [97] to measure personal mastery. This subscale included 4 items (e.g., “*I can do just about anything I set my mind to*”) measuring perceived mastery with the 7-point response format ranging from strongly disagree (1) to strongly agree (7). The final score ranged from 4 to 28, computed by sum scores of all items, with greater scores indicating higher levels of personal mastery. The Sense of Control Scales was previously validated in the general populations [97,98] and recently employed in COVID-19 studies and people with mental [99] and physical health issues indicating high reliability (Cronbach’s alpha = 0.86) [100]. Cronbach’s alpha for the personal mastery scale was 0.54 in this study.

Demographic confounders: Sociodemographic characteristics have also been observed to affect the psychological resilience of individuals during COVID-19 [101]. The main sociodemographic factors that previous studies have demonstrated their effect on resilience are gender [102,103], educational level [101], and income [104]. Participants were asked to report their age, gender, race/ethnicity, education, and annual income. Covid-19 comorbidities and hospitalizations were also measured. See Table 1 for sample demographic information.

2.3. Data analysis

Before analyzing data, we screened for missing values, data entry accuracy, multivariate outliers (i.e., Mahalanobis Distance), proper coding, and normality (i.e., Kurtosis and Skewness tests). Descriptive statistics were determined to summarize demographic characteristics and levels of social support (emotional and instrumental), self-esteem, personal mastery, and resilience of COVID-19 long haulers. We described categorical variables by using frequencies and percentages. For bivariate analysis, Pearson’s correlation coefficients were calculated to assess correlations between our model variables, including social support, resilience, self-esteem, and personal mastery. We conducted statistical tests, t-tests, and analysis of variance (ANOVA) to determine the potential differences in model variables regarding demographic factors, including gender, race/ethnicity, education level, and income. Results indicated a significant difference in social support in terms of gender ($t = 2.052$, $df = 454$, $p = 0.041$), in personal mastery ($F = 3.173$, $p = 0.014$), self-esteem ($F = 3.453$, $p = 0.009$), and resilience ($F = 6.672$, $p = 0.001$) in terms of educational level, and in personal mastery ($F = 3.476$, $p = 0.008$), resilience ($F = 3.822$, $p = 0.005$), and social support ($F = 3.767$, $p = 0.005$) in terms of income. There was no significant difference in study variables regarding race/ethnicity. Data screening and bivariate analyses were conducted using SPSS v23.0.

We conducted Covariance Based Structural Equation Modeling (CB-SEM) with the Maximum Likelihood Estimator (MLE) to examine the hypothesized associations using AMOS v23.0. Guided by Anderson and Gerbing [105], we first utilized confirmatory factor analysis (CFA) to examine the measurement model among latent structures of study variables (i.e., social support, personal mastery, self-esteem, and resilience) for unidimensionality, validity, and reliability of items measuring the construct [106]. The standardized regression coefficients (the factor loadings of manifest factor variables on their corresponding latent variables) and bivariate correlations (among latent variables) were estimated. Manifest factor variables were individual items of a measure, and latent variables were the concepts operationalized by these items, including social support, self-esteem, personal mastery, and resilience.

Then, we examined the hypothesized associations of social support, including its functions (i.e., emotional and instrumental support), with resilience mediated by self-esteem and personal mastery through three mediation structural models with controlled

demographic factors (Fig. 1). All measurement and structural models must meet specific fit indices outlined in the literature [106]. Accordingly, we evaluated the model goodness of fit by calculating the Normed Chi-square ($\chi^2/\text{degree of freedom [df]}$), the goodness of fit index (GFI), the parsimonious comparative fit index (PCFI), and the root means square of approximation (RMSEA). According to Hu and Bentler [107], the model indicates a good fit to data when its goodness of fit indices are $\chi^2/df < 3$, GFI > 0.9 , PCFI > 0.50 , and RMSEA < 0.08 . We estimated the standardized regression coefficients of the paths between latent variables. The indirect effects of self-esteem and personal mastery in the relationship between social support and resilience were examined using MLE.

3. Results

3.1. Demographics and descriptive statistics

For COVID-19 long haulers who participated in this study, the mean age was 32 years (SD = 6.19). Males constituted about 50.2 % of the sample. Ethnically, 70.0 % identified as White/Caucasian, followed by 17.2 % as Black/African American, and 8.9 % as Hispanic/Latino. In terms of educational attainment, the predominant qualification was a bachelor's degree, held by 59.6 % of the participants. Economically, a significant proportion (56.1 %) reported an annual income from \$50,000 to \$100,000. Participants exhibited a mean score of 25.28 (SD = 4.68) for social support metric, 19.14 (SD = 4.76) for resilience indicator, 17.38 (SD = 4.05) for personal mastery metrics, and 27.05 (SD = 4.36) in the domain of self-esteem. Demographics of participants are presented in Table 1.

3.2. Bivariate analysis among study variables

We first performed a bivariate analysis using Pearson's correlation to determine the association between study variables and test hypothesis H1. According to the results presented in Table 2, social support of long haulers, including emotional and instrumental support, was positively correlated with their resilience ($r = 0.443, p < 0.001$) at a moderate level, supporting hypothesis 1 (H1). Results also indicated a positive correlation between social support and long haulers' self-esteem ($r = 0.414, p < 0.001$) and personal mastery ($r = 0.399, p < 0.001$). Thus, higher social support in long haulers is associated with higher self-esteem, personal mastery, and psychological resilience. Self-esteem ($r = 0.470, p < 0.001$) and personal mastery ($r = 0.471, p < 0.001$) were also positively correlated with long haulers' resilience. Regarding the interaction of self-esteem with personal mastery, self-esteem was positively correlated to personal mastery ($r = 0.381, p < 0.001$). All associations were estimated at a moderate level.

3.3. Measurement model

By using confirmatory factor analysis (CFA), we checked the construct validity of the measurement model. The measurement model analysis showed all measurement items were significantly loaded (FLs $> 0.3, p < 0.001$) onto their corresponding latent variables (i.e., social support, self-esteem, personal mastery, and resilience) (see Table 3). The model also indicated a reasonably good fit to data ($\chi^2/df = 1.868$, GFI = 0.902, PCFI = 0.701, and RMSEA = 0.043), suggesting proper latent structures for further mediation analysis.

3.4. Structural equation modeling

SEM was used to examine the hypothesized model of the relationship between long haulers' social support and their resilience mediated by self-esteem and personal mastery in a serial mediation fashion when controlling for demographic factors (i.e., age, gender, annual income, education, and race/ethnicity). The standardized regression weights (β) between latent variables in the social support model are shown in Fig. 2A. In addition to β , unstandardized regression weights (B), critical ratio (C.R.), standard error (S.E.), and p-value for all paths in the social support model are presented in Table 4. Results showed that the structural model of social support explained 79 % variance in resilience, 55.2 % in personal mastery, and 46.4 % in self-esteem. Instrumental and emotional support models explained 78.4 % vs. 88.8 % variance in resilience, 52.2 % vs. 67.8 % in personal mastery, and 41.6 % vs. 36.8 % in self-esteem, respectively. According to the social support model results, the direct path of social support with resilience was not significant ($\beta = 0.193, p = 0.159$), and the association between these two variables was indirectly mediated through self-esteem and personal mastery. Results showed that social support was related to self-esteem ($\beta = 0.681, p < 0.0001$) and personal mastery ($\beta = 0.443, p = 0.002$). The model results suggested three significant paths from social support to resilience, including 1) social support/self-esteem/resilience, 2)

Table 2
Pearson correlations between studied variables (N = 460).

	1	2	3	4	5	6
1. Social support	1					
2. Emotional support	0.773**	1				
3. Instrumental support	0.849**	0.395**	1			
4. Resilience	0.443**	0.379**	0.356**	1		
5. Self-esteem	0.414**	0.280**	0.349**	0.470**	1	
6. Personal mastery	0.399**	0.331**	0.333**	0.471**	0.381**	1

Note: ** $p < 0.001$.

Table 3
Measurement model results.

Construct	Item	Loading Factor	AVE	Cronbach's alpha
Social support	q5071	0.461	0.164	0.609
	q5072	0.382		
	q5073	0.462		
	q5074	0.373		
	q5075	0.345		
	q5076	0.402		
	q5077	0.355		
	q5078	0.448		
Personal Mastery	q5041	0.477	0.228	0.542
	q5042	0.459		
	q5043	0.479		
	q5044	0.496		
Self-esteem	q5051	0.432	0.151	0.640
	q5052	0.384		
	q5053	0.393		
	q5054	0.343		
	q5055	0.334		
	q5056	0.323		
	q5057	0.342		
	q5058	0.421		
	q5059	0.465		
	q50510	0.427		
Resilience	q5061	0.462	0.145	0.575
	q5062	0.386		
	q5063	0.395		
	q5064	0.360		
	q5065	0.304		
	q5066	0.335		
	q5067	0.317		
	q5069	0.399		
	q50610	0.438		

social support/personal mastery/resilience, and 3) social support/self-esteem/personal mastery/resilience. The Chi-square test of the model ($\chi^2/df = 1.852$) and the model-fit indices (GFI = 0.901, PCFI = 0.707, and RMSEA = 0.043) represented a good fit of the social support model to data. These findings support our hypothesis 2 (H2) that the association of social support with resilience in long haulers is mediated by self-esteem and personal mastery in a serial mediation fashion.

Fig. 2B and C illustrate instrumental and emotional support models. The fit statistics of instrumental ($\chi^2/df = 1.877$, GFI = 0.911, PCFI = 0.711, and RMSEA = 0.044) and emotional support models ($\chi^2/df = 1.989$, GFI = 0.910, PCFI = 0.691, RMSEA = 0.046) indicated the good fit of data to these models. Emotional support was related to self-esteem ($\beta = 0.606$, $p < 0.0001$) and personal mastery ($\beta = 0.607$, $p = 0.010$). However, only self-esteem showed a significant relationship with resilience ($\beta = 0.298$, $p = 0.031$) in the emotional support model. While the direct path between emotional support and resilience was not significant, an indirect path through self-esteem mediated the association between emotional support and resilience. Moreover, the path between self-esteem and personal mastery in the emotional support model was not significant. These findings support the potential differences between mechanisms that mediate the influence of social support functions (i.e., instrumental and emotional) on the resilience of long haulers.

3.5. Indirect effects

The results of total and indirect effects in three models of social support and its functions (instrumental and emotional support) are presented in Table 5. For both social support and instrumental support models (Fig. 2A and B), results suggested that self-esteem and personal mastery mediated the association between independent latent variable (social or instrumental support) and resilience ($\beta = 0.552$, $p = 0.001$; $\beta = 0.547$, $p = 0.003$). In addition, findings indicated an association between self-esteem and resilience mediated by personal mastery ($\beta = 0.177$, $p = 0.012$; $\beta = 0.225$, $p = 0.023$). In summary, these results suggested that self-esteem and personal mastery fully mediated the relationships between social/instrumental support and resilience. However, in the emotional support model (Fig. 2C), the indirect effects for personal mastery and self-esteem were not significant ($\beta = 0.316$, $p = 0.316$).

4. Discussion

This research explored a new public health concern prevalent in the post-COVID period, termed 'long COVID'. We analyzed the potential association between social support and its functions (i.e., emotional and instrumental) as an external resource for coping with the psychological resilience of those enduring prolonged COVID-19 symptoms. We investigated whether intrapersonal resources such as self-esteem and personal mastery could mediate this relationship. The findings highlighted the serial mediation of personal mastery and self-esteem in linking social support to resilience in individuals with long COVID.

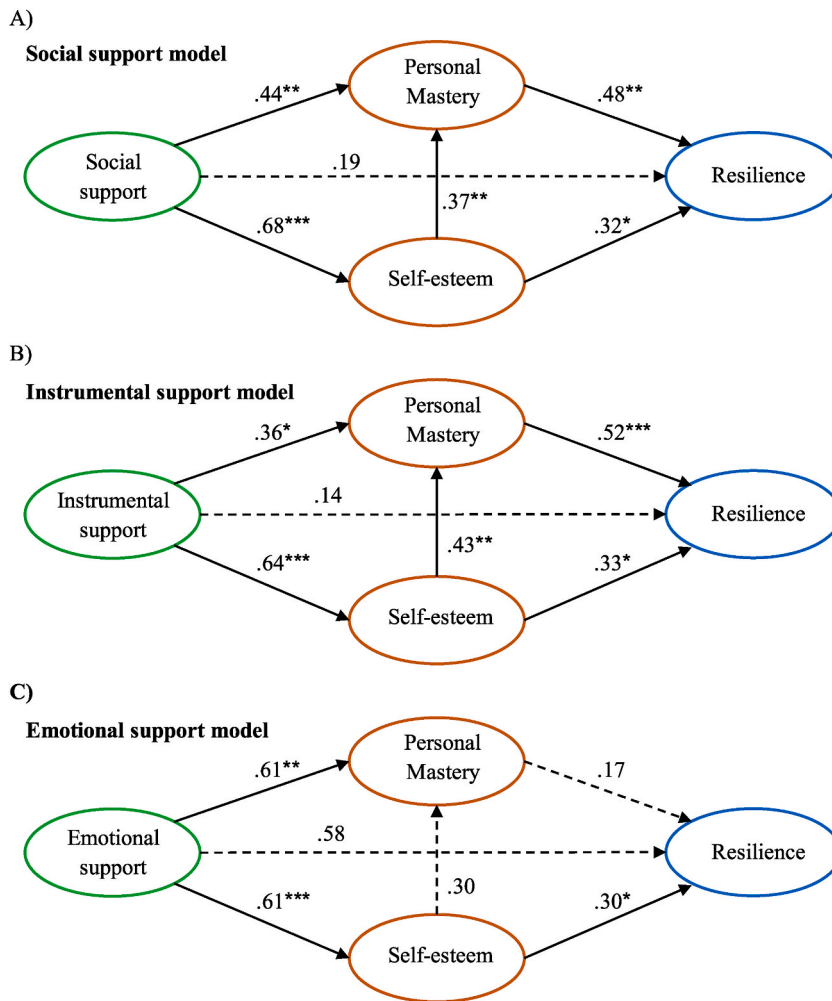


Fig. 2. Three versions of structural model including A) social support model, B) instrumental support model, and C) emotional support model for the whole sample ($N = 460$), with standardized beta weights and significant levels. Solid and dashed lines indicate significant and nonsignificant paths in the model. * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

Table 4
Regression coefficients for pathways in the hypothesized model ($N = 460$).

Variable 1	Variable 2	β	B	S.E.	C.R.	p
Social support	Self-esteem	0.681	0.491	0.092	5.342	0.001
Social support	Personal mastery	0.443	0.580	0.186	3.109	0.002
Social support	Resilience	0.193	0.177	0.126	1.408	0.159
Self-esteem	Personal mastery	0.366	0.665	0.248	2.686	0.007
Self-esteem	Resilience	0.319	0.407	0.168	2.426	0.015
Personal mastery	Resilience	0.483	0.340	0.111	3.048	0.002

Our findings indicated that social support was positively associated with psychological resilience. As supported by previous studies, social support could enhance the resilience of individuals [26,108]. The presence of a reliable and understanding social network could offer long haulers emotional solace, vital information about coping mechanisms, and practical assistance in managing daily tasks. Yet, a recent study on long haulers revealed that such social support comes predominantly from family and close friends [109]. Social support can also counter feelings of isolation, despair, or stigmatization that some long COVID patients might experience [110]. By fostering a sense of belonging and emphasizing their value within a community, social support could reinforce the psychological resilience of long haulers. In our prior investigation [111], we found that a subset of long haulers leveraged emerging digital applications and online platforms to seek social support, which amplified their sense of belongingness. Additionally, social support can provide long haulers with practical resources and approaches for more effective symptom management. This could include reminders

Table 5
Indirect effects.

Effects	β	p-value	95 % CI
Social support model			
Social support – Resilience			
Total effects	0.744	0.001	0.593–0.889
Total indirect effect	0.552	0.001	0.324–0.914
Self-esteem – Resilience			
Total effects	0.496	0.002	0.219–0.780
Total indirect effect	0.177	0.012	0.037–0.460
Instrumental support model			
Instrumental support – Resilience			
Total effects	0.689	0.001	0.490–0.896
Total indirect effect	0.547	0.003	0.333–1.006
Self-esteem – Resilience			
Total effects	0.558	0.009	0.213–0.847
Total indirect effect	0.225	0.023	0.035–0.536
Emotional support model			
Emotional support – Resilience			
Total effects	0.895	0.001	0.683–1.149
Total indirect effect	0.316	0.316	–1.532–0.895
Self-esteem – Resilience			
Total effects	0.349	0.176	–0.309–0.629
Total indirect effect	0.051	0.670	–0.412–0.326

for daily medication intake, assistance in medication reassessment, advocacy for psychopharmacological treatments, and aiding the individual in acquiring the knowledge and skills necessary to handle their symptoms [112]. People with low social support might have less emotional flexibility and be less resilient in tense situations [113]. On the other hand, higher levels of social support could enhance individuals' beliefs that they could get the help required when facing stressful events. This belief would enhance their capacity to deal with adversity and difficulty battling COVID-19 symptoms, leading to higher levels of resilience [26,41,114].

By surveying long haulers, we also found that internal coping resources, including self-esteem and personal mastery, could mediate the relationship between social support and resilience. In contrast, the direct path between social support and resilience was not significant. These results might indicate two possible interpretations. Firstly, the prominence of psychological resources such as self-esteem and personal mastery over other means and factors in fostering resilience among long haulers. Secondly, the findings could highlight potential disparities between long haulers and other vulnerable groups in the social support they received. Our previous study on female long haulers' social lives revealed reduced social support (material and instrumental support) and limited social networks among long haulers due to social isolation and conflict in vaccination beliefs among family and friends. However, they received more social support through social interactions with their peers in social media and online forums [111]. The mediating role of self-esteem in the relationship between social support and resilience in long haulers might indicate that social support positively influences potential deficiencies in the cognitive and social processes related to self-esteem among long haulers. In this regard, a recent study demonstrated an environmental-individual interaction model to assess the relationships between social support, self-esteem, and resilience among university students during COVID-19, which showed that social support may provide a variety of resources and help individuals enhance self-esteem and be more inclined to improve personal adjustment and resilience [50].

Personal mastery was another internal resource that mediated the impact of social support on the long haulers' resilience, consistent with previous studies demonstrating personal mastery as a resilience factor [67] that can be enhanced by social support [47, 65,115]. In line with the association of higher personal mastery with better management of stress in patients with persistent symptoms [116], in the context of long COVID, individuals with a high personal mastery could have a strong belief in their capacity to handle physical and mental symptoms, navigate medical appointments, and seek necessary supports. Moreover, individuals with higher personal mastery tend to be proactive problem-solvers [117]. They might seek out information, try different strategies to manage symptoms, and be more adaptable, enhancing their ability to cope with the uncertainties of long COVID. Individuals with higher personal mastery often set clear goals for themselves. In the face of long COVID, they might set realistic and incremental goals related to their health, rehabilitation, or daily functioning, which can offer a sense of purpose and direction [118].

Examining the survey data using the SEM model supported our hypothesis that self-esteem and personal mastery mediate the relationship between social support and resilience. In the stressful context of COVID-19, long haulers with strong personal mastery may be able to maximize the use of available resources, internal (self-esteem) and external (social support), to promote their resilience and coping with long COVID symptoms [65]. Coping with essential lifestyle changes, limited freedom of movement, different modes of social interactions, and changed working conditions are parts of the new normal for long haulers that require them to take some control over their condition through creativity, flexibility, and problem-solving, which all are embodied in having a strong personal mastery [65]. Our findings highlighted the potential importance of interventions targeting the promotion of personal mastery to foster the resilience of long haulers.

5. Conclusion

This research underscores the significance of social support and its functions (i.e., instrumental, and emotional support) in enhancing psychological resilience among individuals with prolonged COVID-19 symptoms, commonly known as long haulers. The study reveals the critical role of internal coping resources, specifically self-esteem and personal mastery, as mediators between social support and resilience. Our findings highlight that a robust social network, offering emotional and instrumental support, contributes significantly to the resilience and overall well-being of long haulers, underscoring the need for community and familial support structures. Furthermore, the study emphasizes the potential of interventions focused on fostering personal mastery and self-esteem to enhance resilience in this vulnerable group. As long COVID continues to affect populations globally, understanding and leveraging the dynamics of social support and individual psychological resources becomes paramount in designing effective interventions and policies aimed at aiding recovery and improving the quality of life for those affected. This research contributes valuable insights into the psychological recovery process of long haulers and paves the way for future studies and public health strategies to address the ongoing challenges posed by long COVID.

6. Limitations

The present study has some methodological limitations. Firstly, although our participant pool showcases a diverse set of demographic attributes, it might not accurately reflect the typical U.S. population demographics, given the overrepresentation of White individuals (70 %), younger adults (with a mean age of 32 years), and those holding advanced degrees (77 %). Future research using a random or stratified sampling approach would address this limitation and increase the generalizability of study results. Secondly, using an online survey in this research might attract participants with specific biases, such as those possessing advanced computer skills, to the study sample. Thirdly, while we posited the directionality of relationships within the structural equation modeling, the cross-sectional nature of our study design precludes inferring causal relationships. Examining alternative models among the variables using longitudinal data would strengthen the validation of our present results. Fourth, even though the instruments utilized in this study displayed good structural validity based on CFA findings and have previously been validated with consistent psychometric properties across diverse populations, including those with COVID-19, we noticed that they exhibited moderate-to-low reliability and limited convergent validity in some measures. This might be attributed to the transition of psychometric tools from their conventional paper-based formats to online survey platforms, a challenge noted by numerous online COVID-19 studies [119]. Future research could use a combination of methods such as shorter surveys, manual checking of survey responses for inconsistent response patterns, providing different monetary incentives like a donation to charity, and analysis of response time to ensure sufficient data quality in online surveys.

7. Future directions and public health implications

Based on our findings, future therapeutic strategies for COVID-19 long haulers could focus on several key directions: 1) Assessment and Intervention Tailoring: Develop assessments to understand the specific impacts of the pandemic on individuals' social support systems and design interventions that address the altered dynamics of emotional and instrumental support in the context of long COVID. 2) Personal Resource Development: Create therapies aimed at boosting personal resources, with a particular emphasis on increasing self-esteem and fostering personal mastery, which is crucial for enhancing resilience. 3) Customized Support Interventions: Design and implement support interventions that are customized to the unique emotional and practical needs of long haulers, taking into account the diverse psychosocial mechanisms by which social support contributes to resilience. 4) Policy Integration: Advocate for health policy changes that integrate social support services into the care plans for long haulers, recognizing the role of social support in mitigating long-term psychological effects and preparing for future stressors. 5) Psychological Resilience Reinforcement: Develop therapeutic approaches that not only strengthen psychological resilience through intrapersonal and social means but also equip long haulers with the resources needed for ongoing recovery and well-being.

Ethics statement

This study was reviewed by the University of South Carolina Institutional Review Board on May 4, 2021 and received an exemption from Human Research Subject Regulations (Number: Pro00109939) in accordance with 45 CFR 46.104(d) (2) and 45 CFR 46.111(a) (7) due to the minimal risks posed to participants. All participants provided informed consent to participate in the study.

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Data availability statement

The raw data supporting the conclusions of this article are not provided in a publicly available repository. However, data will be made available by the authors on request.

CRediT authorship contribution statement

Atefeh Aghaei: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation. **Shan Qiao:** Writing – review & editing, Supervision, Resources, Project administration, Funding acquisition, Conceptualization. **Cheuk Chi Tam:** Writing – review & editing, Methodology. **Guangzhe Yuan:** Writing – review & editing, Methodology. **Xiaoming Li:** Writing – review & editing, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Shan Qiao reports financial support was provided by National Institutes of Health. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A Supplementary data

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