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Association between caregiving factors and depression symptoms in family caregivers of persons with disabilities during the COVID-19 pandemic in Hong Kong: a structural equation analysis

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ABSTRACT

Objectives Caregiving has been widely recognised as a potential risk factor for caregivers' psychological well-being in previous studies. The objective of this study is to examine the association between multiple factors of the caregiving process and the depression risk of caregivers, as well as the mediating effect of caregiver burden in these associations.

Design Cross-sectional study.

Setting The Hong Kong Polytechnic University in Hong Kong Special Administrative Region, China.

Participants 597 family caregivers of persons with disabilities in December 2020 under the Hong Kong governmental initiative, 'Persons with Disabilities and Rehabilitation Program'.

Main outcome and measures Indications of depression were assessed through the application of the World Health Organization-Five Well-being Index (1998 version).

Results A structural equation model (SEM) was applied using Analysis of Moment Structure (AMOS) 28.0 to identify the association between a series of caregiving-related factors and depression risk, as well as test the mediating role of caregiver burden in these associations. 50% of care recipients needed assistance in all four care need categories, with daily living care being the most prominent (72.4%). Caregivers dedicated around 79.6 hours (SD: 52.2) per week on caregiving duties. Nearly 44% of the caregivers had at least one diagnosed disease. Only 5% of caregivers considered that they had a poor caregiving ability, whereas 87.2% of them reported heightened caregiving pressure during the COVID-19 pandemic. In this study, the average caregiver burden score was 6.6 (SD: 3.3), and the average depression score was 6.7 (SD: 5.1). The results of the SEM model showed that care needs of care recipients (ß (95% CI): –0.201 (–0.355, –0.083), p=0.001), weekly caregiving hours (ß (95% CI): –0.126 (–0.215, –0.067), p=0.001) and presence of emotional issues (ß (95% CI): –0.329 (–0.538, –0.184), p=0.001) were positively associated with depression risk of caregivers, fully mediated by caregiver burden. Additionally, caregivers' health status had both direct (ß (95% CI): –0.234 (–0.388, –0.101), p=0.001) and indirect (ß (95% CI): –0.126 (–0.215, –0.067), p=0.001) effects on depression, indicating that caregiver burden partially mediated this pathway (proportion mediation is 35%). A higher self-evaluation of caregiving ability was related to a lower risk of depression (ß (95% CI): 0.281 (0.169, 0.396), p=0.001), and caregiver burden did not mediate this pathway.

Conclusions Care needs of care recipients, weekly caregiving hours, caregivers' health status and presence of emotional issues during the COVID-19 pandemic were adversely associated with an increased depression risk for caregivers, and these were either fully or partially mediated by caregiver burden. Additionally, caregivers' lower self-evaluation of their caregiving ability was an independent factor that directly contributes to an increased depression risk.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Our study integrated multiple caregiving-related factors, caregiver burden and depression in a single structural equation model, allowing for a comprehensive examination of direct and indirect effects.
- ⇒ Due to the study being conducted during the COVID-19 pandemic, face to face interviews were replaced with online or telephonic interviews, resulting in a considerable amount of missing data.
- ⇒ All data were self-reported, and only caregiver burden and psychological well-being were measured using validated scales.

INTRODUCTION

As of 2021, the number of individuals with disabilities in need of care in Hong Kong exceeded 200 000.[1] Notably, this population relies heavily on family caregivers for informal care. These caregivers, typically family members, provide unpaid assistance and support to individuals with disabilities or age-related issues, playing pivotal roles and having crucial responsibilities in maintaining the care recipient's quality of life and psychological well-being. However, caregiving can cause enormous emotional and physical strain on caregivers.[2] Previous studies have consistently indicated the potential negative impact of caregiving on caregivers' psychological well-being.[3–5] More recent studies have also emphasised the tendency to overlook caregivers' needs, underscoring the need for increased awareness and support.[6] Despite their essential role in society, caregivers often receive little recognition and their needs and challenges remain unnoticed or undervalued. The WHO[7] issued a call to society, urging has called for the establishment of comprehensive support services for caregivers, particularly for those providing prolonged and intensive caregiving. Current existing interventions primarily focus on alleviating caregivers' stress and burdens while enhancing coping skills.[3 8–10] These interventions include services such as day care, respite care, caregiver psycho-education and skill training programmes.

However, the utilisation of support services was disrupted during the COVID-19 pandemic. Such crises not only alter the conventional caregiving landscape but also influence caregiving patterns, stressors and overall caregiving perceptions. The unprecedented challenges of the pandemic potentially reshaped the dynamics of caregiving, thereby leading to changes in the demands and levels of stress on caregivers. During this period, caregivers faced more substantial burdens and heightened stress compared with previous times.[11 12] In addition to these findings, recent studies have provided valuable insights into the challenges faced by informal caregivers across different regions during COVID-19. For instance, a previous study conducted in Japan[13] reported that factors such as care days and times, the use of home care services, and the use of visiting care services were associated with increased caregiver burden. The study also found a significant association between caregiver burden and depressive symptoms. Similarly, a cross-sectional study in Hong Kong[14] suggested that gender, age and employment status were key factors contributing to higher levels of anxiety and depression among caregivers.

Therefore, our study aimed to examine the impact of the COVID-19 pandemic on caregiving dynamics, particularly how disruptions in support services and changes in caregiving demands influenced caregiver burden and stress. By exploring the complex associations between caregiving factors, caregiver burden and depression, this study seeks to provide valuable insights for developing targeted support systems to better assist caregivers in times of crisis.

METHODS

Design and participants

The present study used data collected in December 2020 from the family caregivers of persons with disabilities in Hong Kong. As a cross-sectional study, it formed an integral component of the governmental initiative, 'Persons with Disabilities and Rehabilitation Program'. The primary focus of this investigation was to understand caregivers' needs and the stress they experience, providing the government with substantiated insights to inform the development of service support policies for caregivers. Specifically, this study aimed to examine the association between multiple factors of the caregiving process and the depression risk of caregivers, as well as the mediating effect of caregiver burden in these associations. Notably, written informed consent was obtained from all participants.

Initially, a total of 1756 questionnaires were collected. However, because the study was conducted during COVID-19, face to face interviews were replaced with online or telephonic interviews, resulting in a considerable amount of missing data. Despite this challenge, 1307 valid questionnaires were obtained. After further excluding participants with incomplete information on key study factors, a final sample of 597 participants was included in our analysis. The details of participant selection are shown in figure 1.

Measures

Depression

Psychological well-being was assessed through the application of the World Health Organization-Five Well-being Index (1998 version), a short screening instrument designed to identify indications of depression within the general population. The internal and external validity of this instrument have been evaluated elsewhere.[15] This instrument contains five measurement items: (1) 'I have felt cheerful and in good spirits'; (2) 'I have felt calm and relaxed'; (3) 'I have felt active and vigorous'; (4) 'I woke up feeling fresh and rested'; (5) 'My daily life has been filled with things that interest me'. Participants are required to rate each item on a six-point scale, ranging from 0 to 5, reflecting the frequency of occurrence: 5 for *all of the time*, 4 for *most of the time*, 3 for *more than half of the time*, 2 for *less than half of the time*, 1 for *some of the time* and 0 for *at no time*. Caregivers who obtained lower total scores were considered to have a higher risk of developing depression. The scale demonstrated high reliability, with a Cronbach's alpha of 0.901 in this study.

Caregiver burden

Caregiver burden was assessed using the three-item Zarit Burden Interview–screening version (ZBI–S). This short-form screening tool includes three items: (1) 'Are you afraid of what the future holds for your relative?' (2) 'Do you feel your health has suffered because of your involvement with your relative?' (3) 'Do you feel you have lost control of your life since your relative's illness?' Each item is rated on a five-point Likert-type scale based on how often the caregiver experiences these feelings when providing care (0=*never*; 1=*rarely*; 2=*sometimes*; 3=*quite frequently*; 4=*nearly always*). Higher scores indicated a greater sense of burden. Compared with the original 22-item ZBI, this

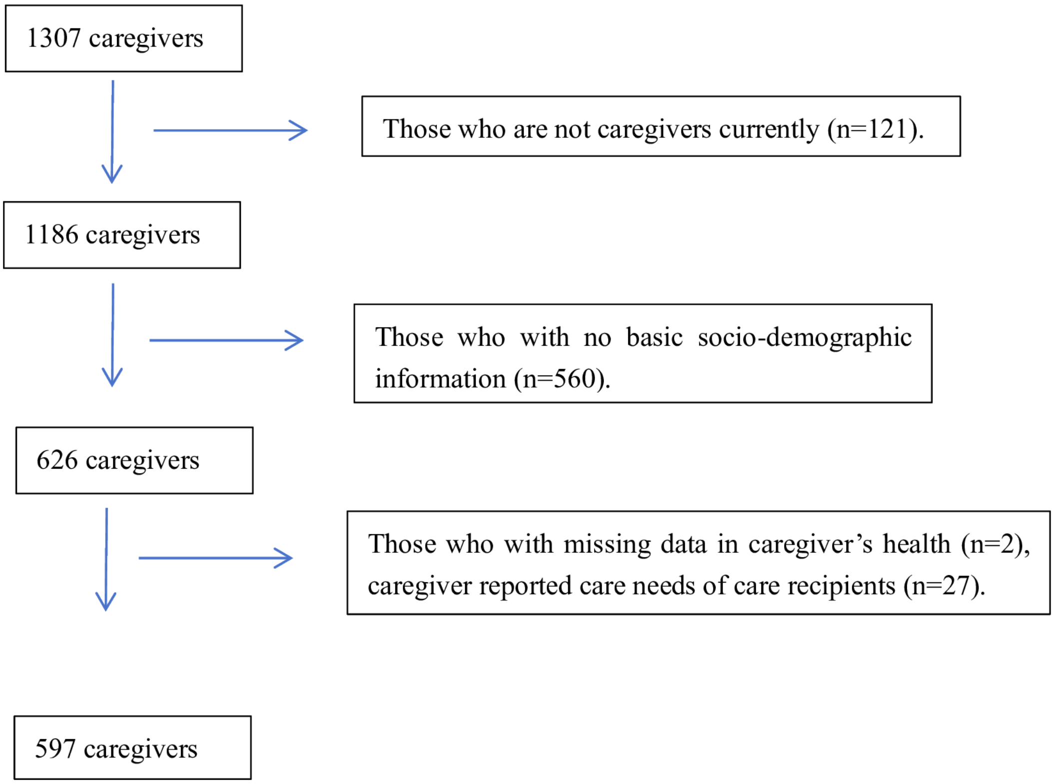

Figure 1 The details of participant selection.

abbreviated three-item ZBI–S has demonstrated acceptable internal consistency, reliability and validity to distinguish significant caregiver burden, particularly among dementia caregivers.[16] Cronbach's alpha for the scale was 0.824 in this study.

Factors of the caregiving process

Caregiver-reported care needs of care recipients

Caregivers were asked to specify the care needs of their care recipient with disabilities by selecting from four multiple-choice options: (1) personal care (eg, eating, drinking, changing, toileting, etc); (2) daily living support (eg, shopping, cooking, doing housework, etc); (3) emotional support; (4) assistance in rehabilitation, medication or treatment.

Weekly caregiving time

Caregivers were required to complete the following two items: (1) 'How many days do you spend caring?'; (2) 'How many hours per day do you spend caring?' Weekly caregiving time was calculated by multiplying working hours per day by working frequency per week.

Caregiver's health status

The health status of the caregiver was assessed using the following four items: (1) 'How would you rate your general health status on a five-point scale ranging from *very good* to *very poor*?'; (2) 'Do you have any disabilities, including attention deficit/hyperactivity disorder, autism, mental illness, intellectual disability, physical disability, speech difficulties, specific learning difficulties, hearing impairment, visual impairment, visceral disability, or others? Respond with *yes* or *no*'; (3) 'Have you been diagnosed with any of the following conditions (multiple choices allowed): cardiovascular disease, renal disease, cancer, diabetes, stroke, emotional issues, impaired physical mobility, other'. For this item, the types of diagnosed diseases were categorised into five groups based on the number of disease types, ranging from 0 to over 4; (4) 'Do you require long-term medication or regular follow-up consultation? Respond with *yes* or *no*'.

Self-evaluation of caregiving ability

Caregivers were asked to rate their perceived personal ability to care for their care recipient on a five-point scale, ranging from *very poor* to *very good*. Due to a limited number of participants in the *very poor* group, we merged the *very poor* and *poor* groups.

Reasons for increased pressure during the COVID-19 pandemic

Since the study was conducted during the COVID-19 pandemic, we designed a question to assess the additional challenges caregivers faced during this period. Caregivers were first asked whether their caregiving pressure had increased due to the pandemic. Those who reported increased pressure were further asked to select the contributing factors from a list of multiple-choice options: (1) a lack of healthcare information; (2) a lack of antivirus items (eg, masks); (3) affected regular home visit services; (4) affected daycare centre services; (5) emotional and behavioural problems of the care recipient; (6) emotional problems of the caregiver; (7) other reasons.

Sociodemographic factors

Sociodemographic data were collected using a self-designed questionnaire, covering age, gender, type of residence and marital status. The questionnaire included five options for type of residence: public housing, home ownership scheme, leased private house, owned private house and other. Marital status was categorised into five options: single, married, divorced, separated or widowed.

Statistical analysis

We conducted a descriptive analysis of the sociodemographic information using SAS statistics software (V.9.4; SAS Institute Inc., Cary, North Carolina, USA). Subsequently, exploratory factor analysis (EFA) was performed to explore latent variables related to care needs of the care recipient with disabilities, caregiver's health status and reasons for increased pressure during the COVID-19 pandemic. Due to the interpretability challenges associated with the 'other reasons' category for increased pressure experienced due to COVID-19, this item was not included in the EFA. The findings revealed that both the care needs of care recipients with disabilities and caregiver's health status could be represented as a latent variable. Meanwhile, reasons for increased pressure during COVID-19 were categorised into three latent variables: supply deficiency (items 1 and 2), service affected (items 3 and 4) and emotional issues (items 5 and 6). Next, we used confirmatory factor analysis (CFA) to construct measurement models with acceptable fits to the data. Items with standardised factor loadings below 0.4 were excluded from the construct measurement models. According to the results, the 'service affected' latent variable (represented by items 3 and 4) had relatively low factor loadings (0.30 and 0.34, respectively) and was subsequently removed from the construct measurement model.

Before conducting further analyses, Pearson's correlation coefficients were used to examine the correlations among all study variables. The range of the correlation coefficients was from −0.514 to 0.461. A structural equation model (SEM) was then applied using Analysis of Moment Structure (AMOS) 28.0 to identify the association between a series of caregiving-related factors and depression, with caregiver burden as mediator. The analysis adjusted for age, gender, type of residence and marital status. This analysis was conducted to estimate the significant pathway from the factors to depression, the factors to the mediator and the mediator to depression. Several model fit indices were used to assess the adequacy of the SEM model: χ^2/degree of freedom (i.e., Parsimony-Corrected Minimum Discrepancy per Degree of Freedom:(PCMIN/DF)) ≤ 3; goodness-of-fit index (GFI) and comparative fit index (CFI) ≥0.9; the root mean squared error of approximation (RMSEA) ≤0.08. To evaluate the statistical significance of indirect effects of each pathway, we used the bootstrapping bias-corrected method and the PRODCLIN2 method.[17] Similarly, the bootstrapping bias-corrected and percentile methods were used to test the statistical significance of direct effects. The number of bootstrap samples was set at 2000. By evaluating the significance of both indirect and direct effects within each pathway, we were able to ascertain whether caregiver burden was a partial or full mediator of the caregiver factors in relation to depression.

Table 1 Demographic profile of the overall caregiver

Variables	Number	Percentage (%)
Age (years)		
<40	139	23.3
40–50	158	26.5
50–60	147	24.6
≥60	153	25.6
Gender		
Men	106	17.8
Women	491	82.2
Type of living house		
Public housing	257	43.1
Home ownership scheme	84	14.1
Leasing private house	81	13.6
Own private house	146	24.5
Other	29	4.9
Marital status		
Single	37	6.2
Married	477	79.9
Divorced/separated	46	7.7
Widowed	37	6.2

Patient and public involvement statement

Family caregivers of persons with disabilities were randomly recruited throughout the community. Neither family caregivers nor the general public were involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

The demographic profiles of participants are shown in table 1. Approximately half of the caregivers were over 50 years old. The majority were women (82%), and 79.9% were married. In terms of the type of residence, 43% of caregivers were living in public houses, while 24.5% of them were living in owned private houses.

Table 2 shows the distribution of caregiving-related factors. 50% of care recipients needed assistance in all four care need categories, with daily living care being the most prominent (72.4%). On average, caregivers dedicated around 79.6 hours (SD: 52.2) per week on caregiving duties. Nearly 44% of caregivers had at least one diagnosed disease. Only 5% of caregivers considered that they had a poor caregiving ability, whereas 87.2% of them reported heightened caregiving pressure during COVID-19. In this study, the average caregiver burden score was

Table 2 The distribution of the factors related to caregiving process and outcome

Factors	Distribution
Caregiver reported care needs of care recipients, n (%)	
Personal care	334 (56.0)
Daily living support	432 (72.4)
Emotional support	385 (64.5)
Assistance in rehabilitation, medication or treatment	358 (60.0)
Weekly caregiving hour, hours/week, Mean (SD)	79.6 (52.2)
Caregivers' health	
Self-reported general health, Mean (SD)	2.9 (0.9)
Have any disabilities, yes, (%)	103 (17.3)
Have at least one chronic or emotional disease, n (%)	323 (44.1)
Cardiovascular diseases	73 (12.2)
Kidney diseases	5 (0.8)
Cancer	16 (2.7)
Diabetes	54 (9.1)
Stroke	5 (0.8)
Emotional issue	169 (28.3)
Limited mobility	116 (19.4)
Others	15 (2.5)
Require long-term medication or regular follow-up consultation, yes (%)	260 (43.6)
Self-efficacy of caregiving ability, n (%)	
Very poor/poor	30 (5.0)
Moderate	343 (57.5)
Good	176 (29.5)
Very good	48 (8.1)
Reasons for pressure increased during the COVID-19 pandemic, yes (%)	525 (87.9)
Supplies deficiency (item 1 and 2)	169 (32.2)
Service affected (item 3 and 4)	331 (63.1)
Emotional issue (item 5 and 6)	430 (81.9)
Others (item 7)	104 (19.8)
Caregiver burden score, Mean (SD)	6.6±3.3
Depression score, Mean (SD)	6.7±5.1

Bold entries are factors. Non-bold entries are items of the factors.

6.6 (SD: 3.3), and the average depression score was 6.7 (SD: 5.1).

The factor loadings obtained through CFA for the SEMs are shown in table 3. These factors were latent variables represented by multiple observed variables. The caregiver's health status was resolved into four factors, while reasons for heightened pressure during COVID-19 were represented by two latent variables, namely, 'supply deficiency' and 'emotional issues', each encompassing two factors. Care needs of the care recipient had four factors, caregiver burden consisted of three factors and depression was represented by five factors. All factor loadings for each latent construct were statistically significant (p<0.001).

The fits to the data for the SEM showing the effect of caregiving-related factors on depression were good (PCMIN/DF=2.702; GFI=0.909; CFI=0.903; RMSEA=0.053). As shown in figure 2, we identified four caregiving-related factors (the care needs of care recipients, ß=0.19, p<0.001; weekly caregiving time, ß=0.24, p<0.001; the caregiver's health status, ß=0.24, p<0.001; the presence of emotional issues, ß=0.34, p<0.001) that were all positively associated with caregiver burden. Additionally, caregiver burden (ß=−0.37, p<0.001) was adversely associated with depression.

When testing the CI for direct and indirect effects in each path (online supplemental table 1), we found that the unstandardised indirect effects of care needs of care recipients, weekly caregiving hour, caregiver's health status and presence of emotional issues on depression were ß (95% CI): −0.201 ((−0.355, −0.083), p=0.001), ß (95% CI): −0.079 ((−0.129, −0.042), p=0.001), ß (95% CI): −0.126 ((−0.215, −0.067), p=0.001) and ß (95% CI): −0.329 ((−0.538, −0.184), p=0.001), respectively. All of these indirect effects were statistically significant (ie, 95% CIs were exclusive of zero). However, we did not observe any significant direct effects of care needs of care recipients (ß (95% CI): 0.171 (−0.113, 0.436), p=0.236), weekly caregiving time (ß (95% CI): −0.073 (−0.1145, 0.003), p=0.068) and presence of emotional issues on depression (ß (95% CI): −0.303 (−0.755, 0.031), p=0.064), which suggested that caregiver burden had a full mediation effect on these three paths. Conversely, caregiver's health status had a direct effect on depression (ß (95% CI): −0.234 (−0.388, −0.101), p=0.001), indicating that caregiver burden partially mediated this pathway. Proportion mediation indicates the ratio of indirect effect to total effect. The proportion of mediation by caregiver burden in the path of the health status of the caregiver to depression was calculated as 35% (ß$_{\text{-indirect}}$ / (ß$_{\text{-indirect}}$ + ß$_{\text{-direct}}$)).

Additionally, no significant direct or indirect effects were found for the presence of supply deficiency during the COVID-19 pandemic on depression. On the other hand, a higher self-evaluation of caregiving ability was significantly related to a decreased risk of depression. The direct effect from self-evaluation of caregiving ability to depression also proved to be statistically significant (unstandardised ß (95% CI): 0.281 (0.169, 0.396), p=0.001), whereas no significant indirect effect was observed (unstandardised ß (95% CI): 0.038 (−0.008, 0.099), p=0.110). This suggested that caregiver burden did not mediate the association between the self-evaluation of caregiving ability and depression.

Table 3 Indicators and loading factors in the measurement models of overall sample (n=597)

Measurement models	Indicators	Unstandardised factor loadings	SE	CR	Standardised factor loadings
Caregivers' health					
	General health status	0.656	0.06	10.959	0.528
	Any disabilities	1			0.812
	Number of diagnosed diseases	0.244	0.026	9.496	0.45
	Long-term medication/regular follow-up consultation	0.504	0.038	13.294	0.71
Reasons for pressure increased during the COVID-19 pandemic					
Supplies deficiency	Lack of healthcare information	1			0.463
	Lack of antivirus items (eg, mask)	1.165	0.298	3.906	0.458
Emotional issue	Emotional problems of persons with disabilities	0.799	0.097	8.274	0.608
	Caregiver's emotional problems	1			0.75
Caregiver reported care needs of care recipients					
	Personal care	0.972	0.067	14.536	0.69
	Daily living support	0.981	0.062	15.747	0.773
	Emotional support	0.95	0.065	14.7	0.7
	Assistance in rehabilitation, medication or treatment	1			0.719
Caregiver burden					
	Are you afraid what the future holds for your relative?	0.795	0.047	16.918	0.698
	Do you feel your health has suffered because of your involvement with your relative?	0.968	0.05	19.511	0.827
	Do you feel you have lost control of your life since your relative's illness?	1			0.818
Depression					
	I have felt cheerful and in good spirits.	1			0.821
	I have felt calm and relaxed.	0.963	0.04	24.131	0.847
	I have felt active and vigorous.	0.986	0.04	24.685	0.862
	I woke up feeling fresh and rested.	0.883	0.045	19.631	0.729
	My daily life has been filled with things that interested me.	0.822	0.039	21.174	0.771

CR, critical ratio; SE, standard error.

DISCUSSION

This study explored the association between various caregiving factors and depression among caregivers of care recipients with disabilities in Hong Kong during the COVID-19 pandemic. We found that higher care recipient care needs, longer weekly caregiving hours, poorer caregiver health status, presence of emotional issues and lower self-evaluation of caregiving ability were all associated with an increased risk of depression. This risk was primarily attributed to heightened caregiver burden which intensified the stress of caregiving.

Our study revealed a significant association between heightened care needs of care recipients and the adverse outcome of caregiver depression. This association was found to be fully mediated by an increase in caregiver burden. Previous studies have shown similar findings, suggesting that greater caregiving intensity is related to higher levels of stress and depression symptoms.[18 19] A study conducted in Serbia during COVID-19[20] also reported that factors such as the duration of daily care and the level of care complexity indirectly contributed to depressive symptoms via caregiver burden. In Hong Kong, the cessation of support services, such as daycare services,[21] during the COVID-19 pandemic may have placed additional caregiving demands on caregivers. This increase in care needs might have led to feelings of loss of control or heightened anxiety about the future of the care recipient.

On the other hand, our study found that caregivers spent an average of 79.6 hours per week on caregiving. Longer

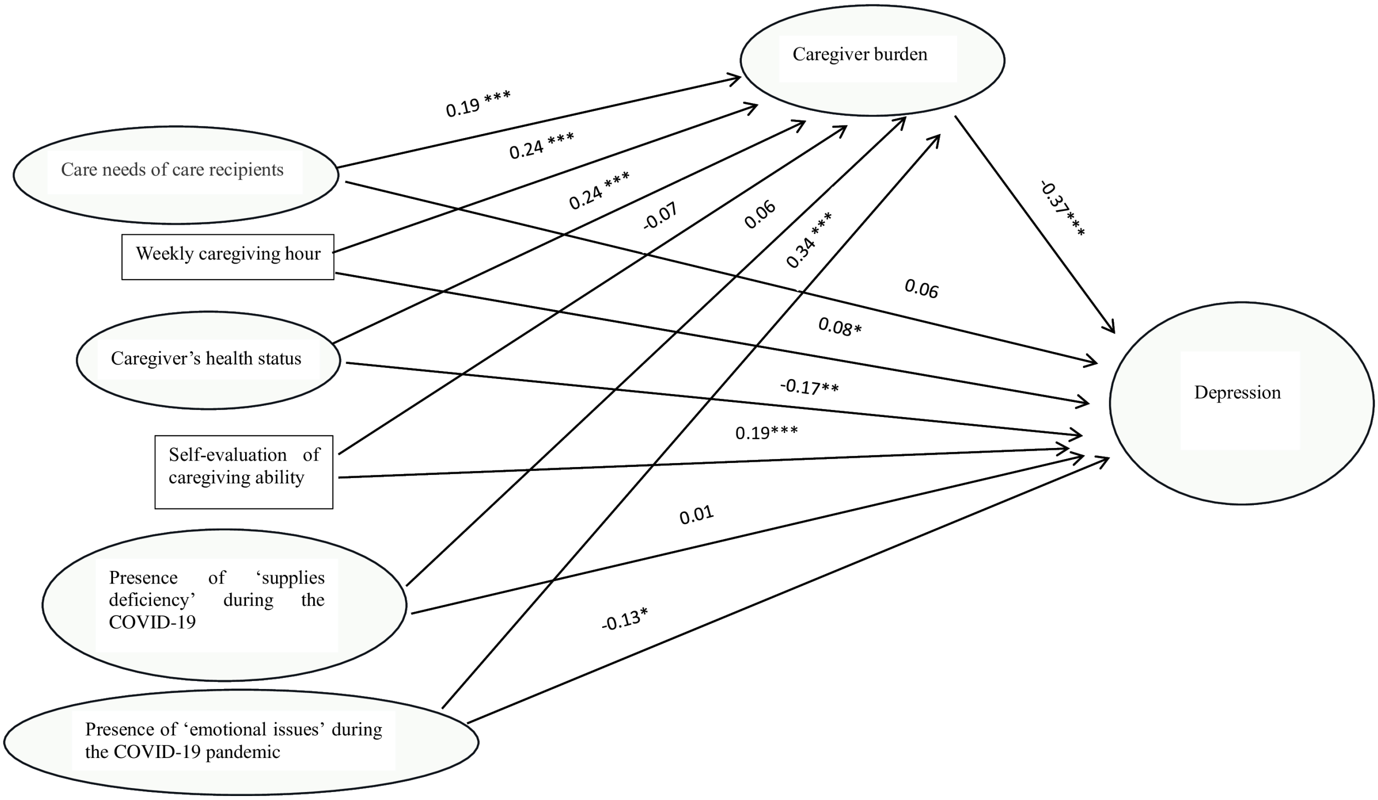

Figure 2 Factors related to the caregiving process and depression risk, mediated by caregiver burden. (*p<0.05; **p<0.01; ***p<0.001)

caregiving time was associated with a higher depression risk, again mediated by caregiver burden. A 2012 Canadian report on the Portrait of Caregivers revealed that most caregivers provided less than 10 hours of caregiving per week,[22] while a cross-sectional study from the USA, conducted in 2005, reported an average of 20 hours per week on caregiving tasks.[23] In contrast, caregivers in Hong Kong devote notably longer hours to caregiving. Informal caregivers of elderly care recipients in Hong Kong spend approximately 56 hours per week,[24] while those caring for individuals with Alzheimer's disease reported a median of 84.8 hours per week.[25] These longer caregiving hours may be rooted in Confucian values, which emphasises filial piety and filial responsibility in Chinese culture.[26 27] Caregivers in Hong Kong who dedicate more caregiving time have also been found to harbour a fervent desire to ensure the well-being of their recipients, which, in turn, can place additional physical and psychological pressure on them. Considering that several previous studies from Western countries have shown that longer caregiving hours have elevated distress levels[18] and increased the risk of developing depression,[20] it is crucial to raise awareness of the psychological strain of prolonged caregiving, especially in Asian societies.

Furthermore, consistent with previous studies,[28–30] our findings indicated that caregivers with poorer self-perceived health are more likely to experience depression, both directly and indirectly, partially mediated by caregiver burden. Specifically, nearly half of the caregivers in our study reported having chronic diseases, emotional issues or disabilities, which may have contributed to a lower self-assessment of their health. A previous study[31] also suggested that the presence of chronic disease and disability negatively impacts emotional well-being and self-perceived health. Conversely, a positive health perception has been shown to have beneficial effects, including the adoption of healthy behaviours, quicker recovery from illnesses and improved overall well-being. Encouraging caregivers to maintain a positive view of their health may therefore be beneficial for both physical and mental health.

The presence of emotional issues in both caregivers and care recipients was a key factor contributing to the increased pressure that caregivers perceived during COVID-19 in our study. Interestingly, this increased emotional pressure was not primarily due to lack of COVID-19 information from the media or shortages of protective supplies and masks. Instead, the intensity and duration of caregiving, as well as caregivers' own health status, played a more substantial role in amplifying emotional strain. Previous studies have similarly reported that caregivers experience greater responsibilities and heavier burdens, subsequent adverse effects on their health and well-being.[32] The pandemic and lockdowns further exacerbated these challenges, leading to even higher levels of depression.[33] Therefore, it is essential to provide sufficient support services and effective psychological interventions, including online mental health-related resources, to help caregivers manage stress during public health crises.

While most of the caregiving-related factors in our study were associated with an increased risk of depression, fully or partially mediated by caregiver burden, caregivers' self-efficacy (found through a self-evaluation of their caring ability) did not follow this factor-mediator-outcome path. Caregivers' self-efficacy refers to their confidence in successfully handling caregiving tasks and overcoming caregiving challenges, reflecting their belief in having control over caregiving problems.[34] Several previous studies have shown that perceived control and mastery influence caregivers' ability to handle caregiving demands.[35 36] In our study, higher self-efficacy was directly associated with a lower risk of depression. These findings reveal that caregiver burden alone may not fully capture caregiving-related stress, and a caregiver' perception of whether they can cope effectively and respond well to the care recipient's demands is equally crucial. Therefore, in addition to identifying caregivers experiencing higher levels of stress using the three-item ZBI–S scale and offering tailored support services based on their perceived stress, interventions aimed at enhancing caregivers' professional knowledge and caregiving coping skills could significantly reduce their depression risk.[37]

Our study had several limitations. First, the causal relationships could not be ensured because our study was cross-sectional. Second, all data were self-reported, and only caregiver burden and psychological well-being were measured using validated scales. Therefore, potential reporting bias and validity measurement issues might exist. Third, the factor loadings for caregivers' health status, presence of supply deficiency and emotional issues as reasons for the increased pressure that caregivers experienced during the COVID-19 pandemic were not very high, which may have affected the accuracy of the research findings. Fourth, the study's sample size limited our ability to analyse associations between caregiving-related factors and depression risk for caregivers of persons with a specific disability. Fifth, these findings apply to caregivers of recipients with disabilities. Further studies should examine whether similar patterns exist among caregivers of elderly individuals.

To the best of our knowledge, few studies have investigated the mediating role of caregiver burden in the association between caregiving-related factors and psychological well-being in Hong Kong. Our study integrated multiple caregiving-related factors, caregiver burden and depression in a single SEM model, allowing for a comprehensive examination of direct and indirect effects. Our findings provide valuable insights for policymakers, emphasising the need for public health policies to support caregivers during public health crises. For instance, it may be necessary to establish e-health intervention systems to address caregivers' mental health challenges during public health crises in the future.

In conclusion, care needs of care recipients, weekly caregiving hours, caregivers' health status and presence of emotional issues during the COVID-19 pandemic were adversely associated with an increased depression risk for caregivers, and these were either fully or partially mediated by caregiver burden. Additionally, caregivers' lower self-evaluation of their caregiving ability was an independent factor that directly contributes to an increased depression risk.

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Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and the study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board of Hong Kong Polytechnic University (reference number: HSEARS20190716003; date of approval: 13 July 2020). Participants gave informed consent to participate in the study before taking part.

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