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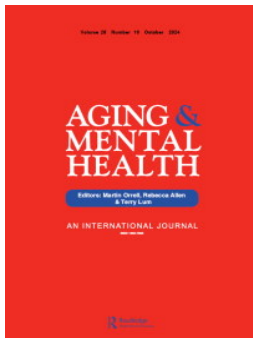
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# COVID-19 infection, resilience, and depressive symptoms: the protective role of family functioning for aging Chinese adults in Hong Kong

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## ABSTRACT

**Objectives:** Older adults are at an elevated risk of experiencing long COVID, with post-COVID-19 depressive symptoms being prevalent. However, the protective factors against this remain understudied. This study examined (a) the role of resilience in the association between COVID-19 infection and depressive symptoms in aging adults; (b) the moderating role of family functioning in the relationships between COVID-19 and resilience and between resilience and depressive symptoms; and (c) potential gender differences in the moderation.

**Method:** Data were drawn from the first wave of the Panel Study of Active Ageing and Society, a representative survey of Hong Kong adults aged 50 or above. Mediation and moderated mediation analyses were conducted.

**Results:** Approximately 35% of the participants had tested positive for COVID-19. Resilience significantly mediated the association between COVID-19 infection and post-COVID-19 depressive symptoms ( $p < 0.001$ ). Family functioning was a significant moderator: the COVID-19-resilience association was stronger, and the resilience-depressive symptoms association was weaker among participants with higher family functioning. The moderating role of family functioning was more salient in women than in men.

**Conclusion:** Resilience can protect aging adults from post-COVID-19 depressive symptoms. Interventions for enhancing family functioning may promote the formation of resilience, especially among older women.

## ARTICLE HISTORY

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## KEYWORDS

Depressive symptoms; family functioning; long-COVID; post-COVID-19; resilience


## Introduction

Coronavirus disease 2019 (COVID-19) has seriously threatened public health globally. As of 27 August 2023, more than 770 million people had been infected, causing 6.9 million deaths (World Health Organization, 2023). In Hong Kong, the number of infected individuals had reached 2.9 million by August 2023, with a death toll of 13,825 (The University of Hong Kong, 2023).

Aging adults of late middle to older ages are disproportionately affected by COVID-19 infection; they face more severe adverse outcomes and have a higher mortality than do individuals in other age groups (Hussien et al., 2021). Globally, approximately one-third of confirmed cases were aged 50 years or older, accounting for 90.7% of total fatalities, with individuals aged 65 years and older accounting for 12.1% of confirmed cases and 70.3% of deaths (United Nations International Children's Emergency Fund, 2022). Even if aging adults survived, they exhibit the greatest risk of developing post-COVID syndrome (Perlis et al., 2022; Whitaker et al., 2022), also known as long COVID. In addition to common physical symptoms, such as fatigue and shortness of breath (Tosato et al., 2021), researchers have paid attention to post-COVID psychological and mental health conditions, including depression, anxiety, sleep disturbance, and post-traumatic stress disorder (Deng et al., 2021; Leung et al., 2020; Liu et al., 2022; Taquet et al., 2021).

Experiencing depressive symptoms is among the most prevalent psychological sequelae that persist in COVID-19 survivors (Khraisat et al., 2022), affecting approximately 45% of patients (Deng et al., 2021). Risk factors for depressive symptoms in these patients include older age, female gender, being married, having a lower socioeconomic status (Kong et al., 2020; Saidi et al., 2021). COVID-19, as a global pandemic, posed unprecedented risks by exposing virtually everyone to immediate and long-term physical and social threats. This occurred in an era where information could disseminate rapidly online, thereby amplifying the potential for negative psychological impacts. However, the mechanism behind COVID-19 infection and depressive symptoms remain unclear. Studies have suggested that resilience may protect against late-life depressive symptoms (Southwick & Charney, 2012). Additionally, family functioning may influence the development of individual resilience and affect how resilience prevents depressive symptoms. Using data from a representative Panel Study of Active Ageing and Society (PAAS) in Hong Kong, this study examined whether resilience mediates the relationship between COVID-19 infection and depressive symptoms. Furthermore, this study investigated whether family functioning moderates the relationships between COVID-19 infection and resilience and between resilience and depressive symptoms. Gender differences regarding the moderating role of family functioning were also explored.

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## ***Resilience as a mediator between COVID-19 infection and depressive symptoms***

Some possible mechanisms for post-COVID-19 depressive symptoms have been suggested. First, COVID-19 can trigger innate immunity and associated inflammation, possibly leading to changes in the brain function and structure linked with depression (Benedetti et al., 2021; Mazza et al., 2022). Second, the psychological stressors related to infection, such as quarantine, isolation, or a family member's infection (Saidi et al., 2021; Zhang et al., 2020), could negatively influence mood and induce neuroinflammation (Mazza et al., 2022). While the majority of empirical evidence supports a positive correlation between COVID-19 infection and depressive symptoms (Liu et al., 2022; Xie et al., 2022; Yuan et al., 2022), there have also been contradictory findings (Naharci et al., 2022). Further investigation into the precise psychosocial mechanisms that shield individuals from developing post-COVID-19 depressive symptoms is necessary.

Resilience is a potential protector against post-COVID-19 depressive symptoms (Southwick & Charney, 2012). Resilience is defined as the ability to recover quickly from adversity, trauma, or other significant sources of stress (American Psychological Association, 2020; Ledesma, 2014). While some studies see resilience as an outcome or process of recovery shaped by stressors and protective factors (Hayman et al., 2017; O'Leary, 1998), other studies refer resilience as the ability to quickly recover and maintain normal or improved functioning under adversities (American Psychological Association, 2020; Hayman et al., 2017). Resilience affects individuals' quality of later life (Hayman et al., 2017). Low resilience leads to more negative and fewer pleasant emotions, which can ultimately manifest as depressive symptoms and other mental health problems (Yi et al., 2020). Resilience can be developed by successfully managing hazards, such as COVID-19 infection (W. Sun et al., 2021). It may boost positive post-COVID outcomes, such as reflection on life goals, improved family and social relationships, and increased awareness of maintaining health (W. Sun et al., 2021). Therefore, resilience is both immediately protective during recovery from infection and enhances protection against depressive symptoms in the future.

## ***Family functioning as a moderator***

From a socioecological perspective, resilience is molded by multilevel protective factors (Van Breda, 2018). As a psychological trait that exists and develops within an individual's microsystem, resilience also involves interactions with a mesosystem (e.g., family or organizations), exosystem (e.g., communities), and macrosystem (e.g., society) (Wister et al., 2022). When individuals in a society have similar support from social policies, families can provide considerable support in recovery from COVID-19 infection (Mohanty et al., 2022; N. Sun et al., 2021).

A family operates as a system that fosters the development and sustenance of members, enabling them to handle basic, developmental, and hazardous tasks through problem-solving, communication, role assumption, affective responsiveness, affective involvement, and behaviour control (Epstein et al., 1978; Miller et al., 2000). The COVID-19 pandemic exerted a complex influence on families. Measures of social distancing and isolation curtailed face-to-face interactions for family members, yet the advent and reliance on digital technology facilitated new forms of online communication (Lee et al., 2022). For

families living together, the increased shared time at home offered opportunities for mutual support, thereby strengthening interpersonal trust (Jiang et al., 2023). However, the alterations in routines, family roles, and boundaries concurrently introduced potential conflicts (Limsuwan et al., 2022; Mohanty et al., 2022; Sheen et al., 2021). Confronted with these challenges, families had to adapt and find ways to maintain harmony and balance, and the manner in which the family interacts and functions together can significantly impact this stress-coping process (Bai and Liu, 2020). Faced with an infectious disease that threatens public health, a well-functioning family can provide substantial support, enabling individuals to overcome COVID-19 infection and its related stressors, thereby fostering resilience.

Family functioning may shape how resilience protects against depressive symptoms. Evidence suggests that the protective role of resilience against depressive symptoms is strongest in emerging adults with poor family cohesion; in such adults, resilience compensates for inadequate family support (Cano et al., 2020). Similarly, the compensatory model of resilience suggests that individual resilience neutralizes exposure to risk factors (Ledesma, 2014). Thus, a dearth of family support may be counterbalanced by substantial resilience, whereas the role of resilience may be less salient when family support is sufficient. Because of the scarce evidence on the influence of family on aging adults' resilience in the context of the COVID-19 pandemic, it remains unclear whether family functioning influences the relationships between COVID-19 infection and resilience and between resilience and depressive symptoms.

## ***Gender differences in the moderating role of family functioning***

The structural gender differences in social and familial support necessitate a gender-based perspective when examining the moderating role of family functioning. Due to the gender role differences and the division of familial labour, women often prioritize family life and are more actively engaged in various family activities than men (Ebimngbo et al., 2021; McLaughlin et al., 2010). Women frequently assume the role of 'kin keepers', responsible for maintaining family relationships and taking care of family members (Carr & Utz, 2020; Kalmijn, 2007). In contrast, older men typically have a weaker family orientation. These structural gender differences translate into distinct patterns of reliance on the quality of family functioning. Older women, who actively engage in various family activities, may be more susceptible to adverse psychological consequences without adequate family support. Previous studies have shown that inadequate family support can specifically lead to mental distress in women (Cheung and Mui, 2023; Choi & Ha, 2011; Hintikka et al., 2000). Consequently, the moderating role of family functioning is likely to be particularly pronounced for women, as changes in family dynamics and support systems can significantly influence their overall psychological well-being.

## ***The present study***

Drawing on data from a representative Panel Study of Active Ageing and Society (PAAS) in Hong Kong, this study examined three hypotheses. First, the study hypothesized that the COVID-19 infection is associated with more severe depressive symptoms among aging adults, with resilience being a protective

mediator in this relationship (Hypothesis 1). Second, family functioning was hypothesized to act as a moderator, influencing the level of resilience developed during recovery from COVID-19, and the protective role of resilience against depressive symptoms (Hypothesis 2). Third, this study hypothesized that the moderation of family functioning is more pronounced among older women than among men (Hypothesis 3).

## Methodology

### Participants and data collection

This study used data from our 'Panel Study of Active Ageing and Society' in Hong Kong, which is designed to be a biennial longitudinal survey conducted with a representative sample of adults aged 50 years and over. Twenty-six thousand landline and mobile phone numbers were randomly generated and dialled according to the numbering plan of the Office of the Communications Authority, Hong Kong SAR Government. When contact was successfully established, one individual was selected to participate from those eligible in each household using the 'next birthday' rule. The respondents were equally stratified by two age groups in 50–64 and 65 and over, and the proportion of participants in each age-sex-district stratum was determined based on the Population Census data in 2021. After the exclusion of invalid phone numbers and the numbers with no target respondent inside the household after verification, 8,303 valid phone numbers were reached. Trained researchers collected the data through 30-min telephone interviews between June 2022 and November 2022. Data collection was aided by a web-based computer-assisted telephone interview (Web-CATI) and on-site supervision for data collection. Of the 8,303 eligible ageing adults, 5,007 successfully completed the questionnaire, yielding a response rate of 60.3%. The 3,296 unsuccessful cases included non-contacts (after at least five attempted calls) and refusals. All study procedures and protocols were approved by the institutional review board of the first author's affiliated university, and respondents' informed consents were collected.

### Measurements

#### COVID-19 infection

Respondents were asked if they had ever been infected with or tested positive for COVID-19. Responses from those who had been infected were recoded as 1 (infected), while those who had tested negative or were unsure were recoded as 0 (not infected).

#### Resilience

Resilience was assessed using the two-item Connor-Davidson Resilience Scale (Vaishnavi et al., 2007), asking the respondents' ability of (a) 'being able to cope with life or societal changes' and (b) 'being able to recover from illness, injury, or suffering.' Answers ranged from 0 (never) to 4 (almost every day). The total score ranged from 0 to 8, with a higher score indicating greater resilience. Cronbach's Alpha for the scale was 0.85 in this study.

#### Family functioning

Family functioning was assessed using the Brief Assessment of Family Functioning Scale (BAFFS), a three-item version of the

General Functioning Scale of the Family Assessment Device (Mansfield et al., 2019). The General Functioning Scale has been validated (Shek, 2001), and the BAFFS has been used in Hong Kong studies, with internal consistency ranging from 0.71 to 0.77 (Lai et al., 2020, 2022). Respondents were asked to rate the three statements (e.g., we can express feelings to each other) on a scale of 1 (strongly disagree) to 4 (strongly agree). The unweighted sum of the three items was calculated, with a possible range of 3–12 and a higher score indicating stronger family functioning. The Cronbach's Alpha for BAFFS was 0.689 in this study. Given its brevity, the BAFFS's internal consistency of the BAFFS was moderately satisfactory, with Cronbach's Alpha approximately around 0.7 (Mansfield et al., 2019; Taber, 2018). This level of consistency, while acknowledged as a limitation in the original study (Mansfield et al., 2019), was deemed reasonable due to the scale's concise three-item nature.

#### Depressive symptoms

Depressive symptoms were assessed using the eight-item Centre for Epidemiologic Studies Depression Scale (Van de Velde et al., 2009). The scale has been validated in a Chinese context (Liu et al., 2023; Yang et al., 2021). Respondents were asked to rate the frequency at which they experienced depressive symptoms on a 4-point scale (1 = rarely or none of the time, 4 = all of the time). The unweighted sum of eight items was calculated, ranging from 0 to 24. A higher score indicated severe depressive symptoms. The Cronbach's Alpha for the scale in this study was 0.79.

#### Covariates

This study controlled for respondents' age, sex (0 = men, 1 = women), marital status (0 = never married, separated, divorced or widowed, 1 = married or cohabiting), cohabitating status (0 = not living alone, 1 = living alone), working status (0 = not retired, 1 = retired), level of education (0 = below secondary, 1 = secondary or higher), estimated monthly household income (based on the midpoints of the selected income ranges), and self-rated health (assessed on a 5-point Likert scale, with 1 = very poor, 5 = very good).

### Data analyses

Data analyses were performed using SPSS 26 (IBM Corp, 2016). Descriptive analyses were conducted to obtain the mean and standard deviation (SD) for each variable, and intercorrelations between key variables were subsequently examined. Both unweighted and weighted statistics were reported, with the weighted statistics incorporating age, sex, and district population proportions from the 2021 Population Census. The differences between the infected and non-infected subgroups were compared using Student's *t*-test. Statistical significance was set at  $p < 0.05$ .

Figure 1 presents the conceptual framework for analysis. To test the hypotheses, mediation model and moderated mediation models were performed using the PROCESS macro (Models 4 and 58). Model 4 was first used to examine the hypothesized mediating role of resilience by testing the presence of a significant indirect effect between COVID-19 infection and depressive symptoms through resilience. Second, Model 58 was applied to test the moderating role of family functioning in the associations between COVID-19 infection and resilience and between resilience and depressive symptoms. To compare gender differences in the moderating role, the model was also performed



separately for women and men. The statistical significance of the direct and indirect effects was evaluated by using 5,000 bootstrap samples to create bias-corrected 95% confidence intervals (CIs) with heteroscedasticity-consistent standard errors (SEs) (Hayes, 2017). To better understand the moderating effect, we further used the Johnson-Neyman technique to identify the range of values of moderator where the effect of resilience is statistically significant. Covariates were controlled in all mediation and moderation analyses. All continuous variables in the interaction terms were centred.

## Results

### Sample characteristics

As shown in Table 1, the average age of the 5,007 respondents was 64 years, and 54% of them were women. Approximately 35% of the respondents had tested positive for COVID-19, and men had a higher risk of infection. Those infected were more likely to be married, living with others, not being retired, and being better educated. These individuals reported superior self-rated health, greater depressive symptoms, greater resilience, and poorer family functioning than did the non-infected group (all  $p < 0.05$ ). Bivariate correlations between the key study variables are presented in Supplementary Table 1.

### Mediation model analyses

Figure 2 presents the mediation model. COVID-19 infection was directly and significantly associated with the development of depressive symptoms, and significantly associated with higher individual resilience. Resilience was significantly related to less severe depressive symptoms. The total effect of COVID-19 infection on depressive symptoms was 0.38 ( $p < 0.001$ , 95% CI [0.18,

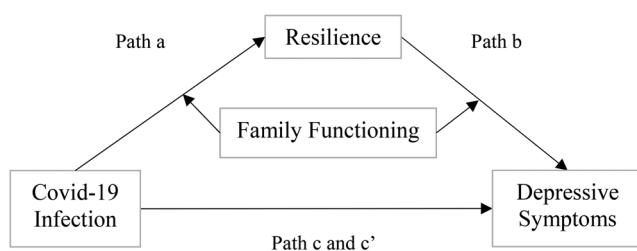


Figure 1. Conceptual framework.

0.58]). The indirect mediated effect of infection on depressive symptoms ( $\beta = -0.20^{***}$ ,  $p < 0.001$ , 95% CI [-0.25, -0.16]) was also significant, accounting for 65.12% of the total effect. The effect of COVID-19 infection on depressive symptoms was partially mediated by resilience, supporting Hypothesis 1.

### Moderated mediation model analyses

The moderated mediation model is presented in Table 2, which includes family functioning as a moderator on the relationship between COVID-19 infection and resilience, as well as resilience and depressive symptoms. Both interaction terms were significant ( $\beta = 0.23^{***}$ ,  $p < 0.001$ , 95% CI [0.17, 0.28];  $\beta = 0.07^{***}$ ,  $p < 0.001$ , 95% CI [0.04, 0.09]), supporting Hypotheses 2. Effects of COVID-19 infection on resilience, resilience on depressive symptoms, and the indirect effect of COVID-19 infection on depressive symptoms varied at different levels of family functioning. The results of the full model can be found in Supplementary Table 2.

As shown in Table 3, higher family functioning amplified the positive association of infection on resilience, while it attenuated the negative association of resilience and depressive symptoms. Supplementary Table 3 presents the results of the full model. Individuals with stronger family functioning were more likely to develop resilience following infection. However, the resilience did not mitigate depressive symptoms to the same extent as it did for those with weaker family functioning. Figure 3 shows the Johnson-Neyman plot for conditional effects. When the family functioning score was lower than 6.14, the indirect effect of infection on resilience was negative ( $p < 0.05$ ). When the family functioning score was higher than 7.62, this influence was positive ( $p < 0.05$ ). The area in-between demonstrated no significant effect. This means the significant conditional effect was with the 5.89% of participants whose family functioning scored 6 or lower, and the 86.16% scored 8 or above. For the positive link between resilience and depressive symptoms, no statistically significant transition points were identified, and the relationship was always significant.

### Gender differences

As presented in Table 3, the coefficient of the interaction term 'COVID-19\*Family Functioning' was larger for women than for men (women model:  $\beta = 0.26^{***}$ ,  $p < 0.001$ , 95% CI [0.19, 0.34];  $\beta = 0.19^{***}$ ,

Table 1. Respondent characteristics.

	Total (N = 5007)		By infection status		t-test p-value
	Weighted	Unweighted	Infected (n = 1743, 35%)	Non-infected (n = 3264, 65%)	
Age	64.10 (9.30)	64.22 (8.35)	63.05 (7.83)	64.84 (8.55)	0.00
Female (0–1)	0.54 (0.50)	0.54 (0.50)	0.50 (0.50)	0.55 (0.50)	0.00
Married (0–1)	0.71 (0.45)	0.72 (0.45)	0.75 (0.43)	0.71 (0.45)	0.00
Living alone (0–1)	0.16 (0.36)	0.15 (0.36)	0.12 (0.33)	0.17 (0.38)	0.00
Retired (0–1)	0.49 (0.50)	0.51 (0.50)	0.42 (0.49)	0.56 (0.50)	0.00
Highschool education (0–1)	0.48 (0.50)	0.46 (0.50)	0.48 (0.50)	0.45 (0.50)	0.04
Household income (monthly/HKD)	31,953.75 (19,953.38)	31,444.43 (19,555.65)	34,012.05 (19,965.44)	30,073.3 (19,555.65)	0.00
Self-rated health (1–5)	3.25 (0.83)	3.26 (0.81)	3.30 (0.78)	3.24 (0.82)	0.02
Depressive symptoms (0–24)	5.27 (3.70)	5.19 (3.63)	5.34 (3.67)	5.11 (3.61)	0.04
Resilience (0–8)	4.17 (1.86)	4.21 (1.85)	4.57 (1.79)	4.01 (1.85)	0.00
Family functioning (3–12)	9.34 (1.73)	9.33 (1.74)	9.22 (1.86)	9.39 (1.67)	0.00

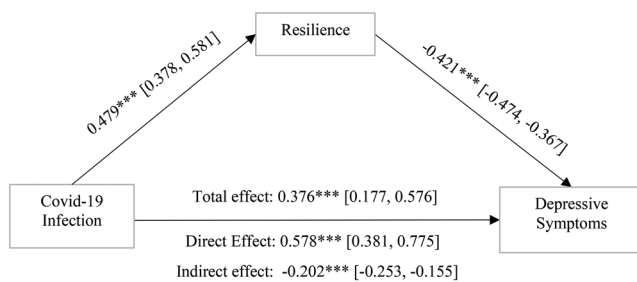
Note: Mean and standard deviation (SD; in parentheses) reported. The weighting was based on the age, sex, and population proportions of each district derived from the Population Census data in 2021. The statistics for the infected and non-infected subgroups were not weighted.

$p < 0.001$ , 95% CI [0.11, 0.27]). The coefficient of the interaction term 'Resilience\*Family Functioning' was significant only for women ( $\beta = 0.102^{***}$ ,  $p < 0.001$ , 95% CI [0.07, 0.14]) but not for men. These findings supported Hypothesis 3 that the moderation effect of family functioning is stronger in women than in men.

Figure 4 plotted the conditional effect of COVID-19 on resilience at family functioning levels at 16th, 50th, and 84th percentile for both genders. Differences in slopes and coefficients indicated that family functioning had a greater moderating effect on women than on men. However, the likelihood of obtaining resilience after infection, and the protective role of resilience against depressive symptoms, were at higher levels in men than in women. When family functioning was lower at 8, COVID-19 infection only brings resilience in men but not women. When family functioning was higher at 11, resilience still significantly reduced depressive symptoms in men, but the reduction was slight in women.

## Discussion

Drawing on data from a representative sample of adults aged 50 years and over in Hong Kong, this study found that resilience effectively mediated the association between COVID-19 infection and post-COVID-19 depressive symptoms. In addition,



**Figure 2.** The mediating role of resilience on the relationship between COVID-19 infection and depressive symptoms. Note. Model adjusted for age, sex, marital status, living alone, retirement status, high school education, household income, and subjective health. \*\*\* $p < 0.001$ .

family functioning significantly moderated the relationships between COVID-19 infection and resilience and between resilience and depressive symptoms. Individuals infected by COVID-19 were more likely to develop resilience if they had higher family functioning, and resilience's protective role against depressive symptoms was more evident in people with weaker family functioning. Beyond examining resilience at an individual level, our findings highlight the importance of understanding resilience formation in response to COVID-19 infection and the influence of resilience on depressive symptoms in broader family contexts. Furthermore, the study identified a gender difference in which the moderation of family functioning was stronger for women.

The descriptive results demonstrate the socio-demographic differences between infected and non-infected older adults in Hong Kong. Approximately 35% of the sample had been infected by COVID-19. This figure is comparable to the 36.15% infected rate of people aged 50 and older reported regarding the fifth wave of COVID-19 in Hong Kong (The Government of the Hong Kong Special Administrative Region, 2023). Compared with the non-infected group, infected respondents had a higher likelihood of being men, being married, not living alone, not being retired, and being more highly educated, consistently with the risk factors for COVID-19 infection identified in previous studies (Pijls et al., 2021; Pinto Saravia, 2022). Ageing adults in high-functioning families may receive more support and reminders from family members regarding precautionary and hygiene measures to avoid infection; thus, non-infected individuals exhibited higher family functioning. In addition, infected ageing adults reported greater depressive symptoms and resilience, indicating that COVID-19 infection may induce relevant psychological reactions (Serafini et al., 2020).

By examining resilience as a mediator, our study demonstrates that although infection experience directly led to greater depressive symptoms, the adverse effects of COVID-19 infection could be alleviated by the associated enhancement in resilience. COVID-19 infection was significantly associated with higher

**Table 2.** Test for moderated mediation model.

	<i>B</i>	<i>SE</i>	<i>T</i>	LLCI	ULCI	<i>R</i> <sup>2</sup>
Outcome: resilience						0.171
COVID-19 infection	-1.591***	0.265	-6.001	-2.110	-1.071	
Family functioning	0.083***	0.018	4.581	0.047	0.118	
COVID-19*Family functioning	0.227***	0.028	8.089	0.172	0.282	
Family functioning Conditional effect of COVID-19 on resilience						
8 (16th percentile)	0.222***	0.062	3.576	0.100	0.344	
9 (50th percentile)	0.449***	0.051	8.746	0.348	0.550	
11 (84th percentile)	0.902***	0.070	12.918	0.765	1.039	
Outcome: depressive symptoms						0.258
COVID-19 infection	0.340***	0.096	3.548	0.152	0.528	
Resilience	-0.955***	0.129	-7.427	-1.207	-0.703	
Family functioning	-0.930***	0.062	-14.883	-1.052	-0.807	
Resilience*Family functioning	0.068***	0.013	5.072	0.042	0.094	
Family functioning Conditional effect of resilience on depressive symptoms						
8 (16th percentile)	-0.412***	0.032	-12.788	-0.475	-0.349	
9 (50th percentile)	-0.344***	0.027	-12.89	-0.396	-0.292	
11 (84th percentile)	-0.208***	0.034	-6.186	-0.274	-0.142	
Conditional indirect effect of COVID-19 on depressive symptoms						
Family functioning		Index	BootSE	BootLLCI	BootULCI	
8 (16th percentile)		-0.092	0.027	-0.147	-0.040	
9 (50th percentile)		-0.155	0.022	-0.200	-0.114	
11 (84th percentile)		-0.188	0.034	-0.257	-0.124	

Note. Model adjusted for age, gender, marital status, living alone, retirement status, high school education, household income, and subjective health.

\*\*\* $p < 0.001$ .

individual resilience, which in turn was associated with weaker depressive symptoms in ageing adults, supporting the protection of resilience against post-COVID-19 depressive symptoms (Song et al., 2020). Essential elements of resilience (e.g. problem-solving ability, emotional regulation, optimism) can be cultivated by managing infection-related stress during infection (W. Sun et al., 2021), which can promote the positive coping, adaptation, and overall well-being of older individuals (Naharci et al., 2022).

Our findings further suggested that the protective role of resilience should be understood in broader social systems in relation to the moderating effect of family functioning. Relevant studies have emphasized the importance of family functioning in helping children (Mariani Wigley et al., 2021) or young adults (Sahanowas & Halder, 2019) develop resilience. This study adds to prior findings that healthy family functioning helps older adults to cope with adversity and improve psychological resilience. Favourable family functioning arises from positive interaction patterns among family members (e.g. frequent

communication, problem-solving, and affectional closeness), promoting a supportive environment that is loving, emotionally responsive, and reliable (Southwick & Charney, 2012). In addition, the association between resilience and depressive symptoms was weaker among individuals with higher family functioning, implying a possible compensatory effect between individual resilience and family functioning in preventing mental health problems (Cano et al., 2020). Consistent with Li et al. (2021), we suggest that family support may have compensated for the negative impacts of low resilience on mental health amid the COVID-19 pandemic.

This study identified gender differences in relation to the role of family functioning, with a greater moderating effect observed among women. The resilience women developed in response to the COVID-19 infection was highly contingent on the level of family functioning. Notably, for women in the lowest 16% of family functioning, there was no significant correlation between their resilience and infection. Moreover, the level of family functioning among women significantly influenced the protective role of resilience against depressive symptoms. In contrast, men's resilience was not influenced by family functioning, consistently providing them a higher level of protection compared to women. These findings support our hypothesis on the greater moderation role of family functioning among older women, as shaped by the structural gender role differences and its impact on women's psychological and emotional well-being. Our study echoed a previous study that identified the stronger role of healthy family functioning in alleviating mental distress among older women living in poverty (Bai et al., 2020). Given women's typically stronger orientation towards family, weak family functioning and inadequate family support can impede their resilience-building process when dealing with the COVID-19 infection. In terms of depressive symptoms, women with strong family functioning can draw upon effective protective resources from their family, while those with weak family functioning must rely on their own resilience to manage the symptoms. In contrast, men are less susceptible to the influence of family functioning, and thus their resilience consistently offers them protection.

### Implications

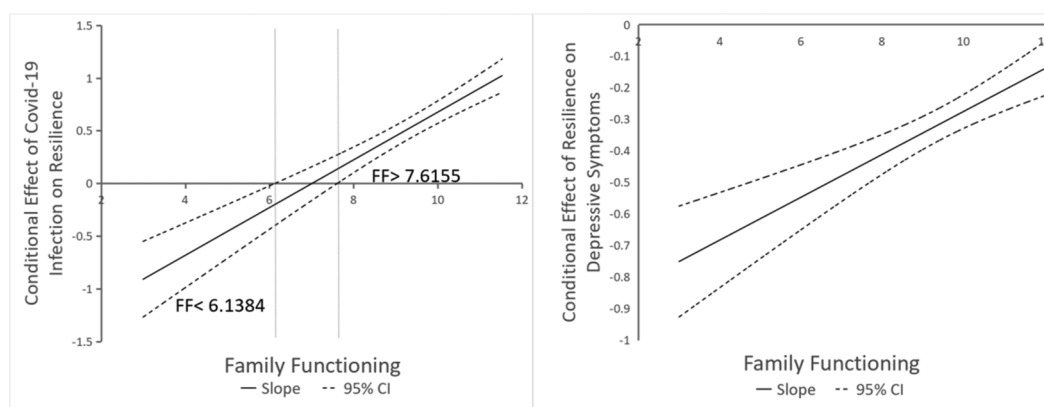
Future research could be informed by this study in three directions. First, the protective mediating role of resilience invites further exploration of how resilience develops over time, and how dynamic resilience affects multiple health outcomes.

**Table 3.** Moderated mediation model for women and men.

	$\beta$	SE	T	LLCI	ULCI	R <sup>2</sup>
Model 1: women (n = 2679)						
Outcome: resilience						0.176
COVID-19 infection	-2.081***	0.359	-5.805	-2.784	-1.378	
Family functioning	0.064**	0.024	2.698	0.017	0.110	
COVID-19*Family functioning	0.264***	0.038	6.934	0.189	0.338	
Outcome: depressive symptoms						0.266
COVID-19 infection	0.590***	0.134	4.408	0.327	0.852	
Resilience	-1.238***	0.182	-6.818	-1.595	-0.882	
Family functioning	-1.116***	0.086	-13.038	-1.284	-0.948	
Resilience*Family functioning	0.102***	0.019	5.411	0.065	0.139	
Model 2: men (n = 2328)						
Outcome: resilience						0.175
COVID-19 infection	-1.137**	0.394	-2.888	-1.910	-0.365	
Family functioning	0.105***	0.028	3.776	0.050	0.159	
COVID-19*Family functioning	0.192***	0.042	4.635	0.111	0.274	
Outcome: depressive symptoms						0.252
COVID-19 infection	0.082	0.138	0.597	-0.188	0.352	
Resilience	-0.596**	0.183	-3.261	-0.955	-0.238	
Family functioning	-0.700***	0.092	-7.631	-0.879	-0.520	
Resilience*Family functioning	0.026	0.019	1.393	-0.011	0.064	

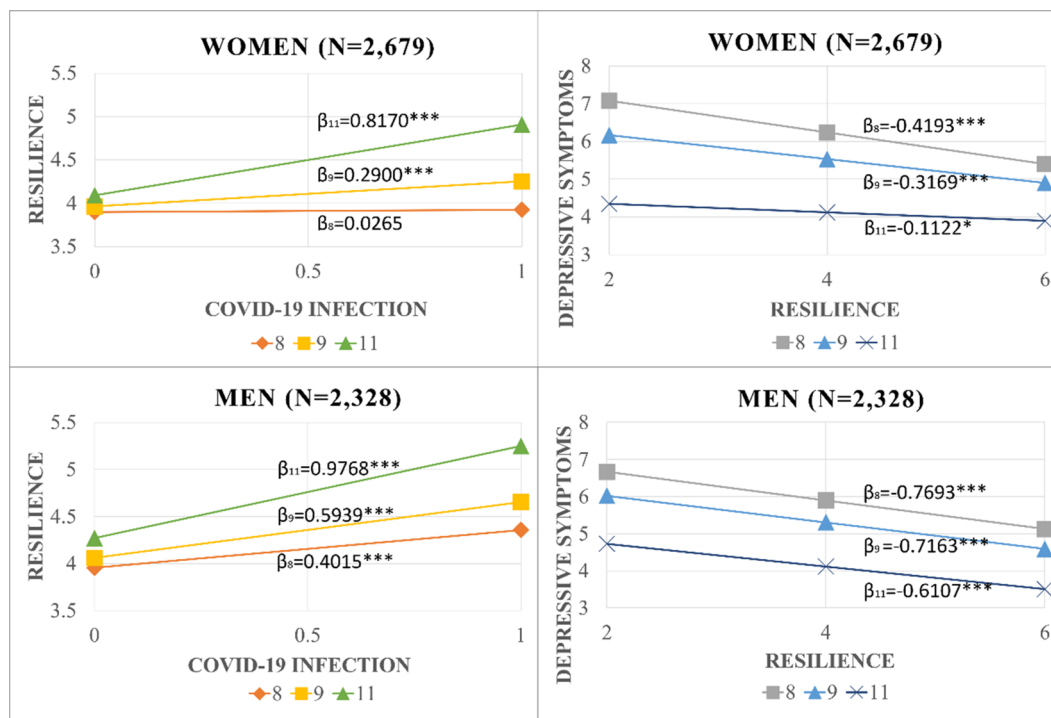
Note. Model adjusted for age, marital status, living alone, retirement status, high school education, household income, and subjective health.

\*\* $p < 0.01$ , \*\*\* $p < 0.001$ .



**Figure 3.** The Johnson-Neyman graph for probing conditional effects.





**Figure 4.** Conditional effect of COVID-19 infection on resilience at different levels of family functioning for subgroups. Note. Coefficients presented. Model adjusted for age, marital status, living alone status, retirement status, high school education, household income, and subjective health. The interaction terms of the model for depressive symptoms were non-significant for men. All other interaction terms were significant at the 1% level.

Second, the moderating effect of family functioning on resilience development and bearing depressive symptoms indicates the necessity for attention to broader multi-level social systems. For example, future research may investigate how resilience and its influence can be attenuated or strengthened by interpersonal relationships, community cohesion, or different welfare regimes across cultures. Third, the gender differences in the moderation of family functioning should urge scholars to examine how multiple social identities (e.g., race, age, sexuality) interactionally interact with gender to yield contextualized inequality.

This study has practical and policy implications for formulating interventions to enhance resilience and mitigate mental hardship. Disease as a stressor also provides opportunities for individuals to develop the ability to recover. MacLeod et al. (2016) recommend the use of cognitive behavioural therapy or mindfulness for building resilience (MacLeod et al., 2016). Online and offline counselling services should be made available to older adults facing health situations. Professionals and service providers should reconsider the effectiveness of nurturing resilience and preventing mental disorders among older adults with different family characteristics and social conditions. Because of the compensatory effect of individual resilience in the relationship between family functioning and depressive symptoms, multiple sources of social support should be provided to older adults especially those with low levels of resilience, who may rely more on extraneous assistance to cope with depressive symptoms. Special attention should be paid to older women whose psychological well-being seems to be more sensitive to external support.

### Limitations and conclusion

This study has a few limitations. First, because of the cross-sectional nature of this research, causal inferences between

COVID-19 infection, resilience, and depressive symptoms could not be tested and established. The data were from the first wave of the Panel Study of Active Ageing and Society; longitudinal data analyses is necessary in the future to further establish the causality of the relationship. Second, the analysis did not incorporate detailed living arrangements or the proximity of family members. This omission may have restricted our understanding of how family functioning can fructify and exert varying influences. Third, although the Brief Assessment of Family Functioning Scale (BAFFS) has been used locally, there is a need for rigorous validation studies in the future. Fourth, older adults with lower psychological resilience may have a higher mortality risk (Ghulam et al., 2021; MacLeod et al., 2016), might have been less likely to participate in our survey. This could potentially introduce a selection bias. In relation to this, this first wave of the survey did not collect information on mortality and other long-COVID symptoms that could affect depressive symptoms and mortality. Future iterations of the survey could consider incorporating an exit questionnaire and retrospective questions on long-COVID symptoms during data collection.

This study represents one of the first explorations into the protective role of resilience against the negative impacts of COVID-19 infection on mental health among older adults. It revealed that the development of resilience post-infection and its influence on depressive symptoms varied with family functioning levels. A gender perspective further elucidated the moderating role of family functioning, demonstrating its complex influence on individual resilience formation and reduction of depressive symptoms. This research, conducted in Hong Kong, offers insight into the experiences of aging East Asians where family ties and cultural norms bear similarities. While caution should be exercised when generalizing these findings to regions with vastly different cultural backgrounds, this study nonetheless highlights crucial global themes. It acknowledges the

capacity of ageing adults for post-traumatic growth and the role of resilience in alleviating depressive symptoms. Notably, gender differences in well-being in the face of family dynamics suggest the need for targeted care and support. Enhancing family functioning may be crucial for boosting resilience and further overcoming distress for women, while for men, cultivating independent resilience appears paramount. Overall, the study provides a valuable reference to inform aging-related practices and policy reforms across diverse societies.

## Disclosure statement

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