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Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Low assets predict persistent depression through living difficulties amid large-scale disasters: A cohort study

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ARTICLE INFO

Keywords:

Assets
Daily routines
Financial hardship
Depression
COVID-19
Conservation of Resources

ABSTRACT

Background: In face of large-scale disasters, persons with fewer assets are at greater risk of persistent poorer mental health than persons with more assets. Everyday daily routine disruptions and financial hardship could mediate this association.

Methods: This prospective population-representative study in Hong Kong aimed to investigate the relation between assets during the acute phase of COVID-19 (February–August 2020, T1) and persistent probable depression from T1 to March–August 2021 (T2), as well as the mediating effects of daily routine disruptions and financial hardship on the assets-depression association.

Results: Low assets at T1 prospectively related to persistent probable depression from T1 to T2. Primary routine disruptions (i.e., healthy eating and sleep) at T1 and financial hardship at T2 were found to fully mediate the association between T1 assets and persistent probable depression.

Limitations: Persistent probable depression reported on the PHQ-9 should be further verified with clinical diagnoses/interviews.

Conclusions: The COVID-19 pandemic was accompanied by a global economic downturn. Persons who have fewer assets could be at greater risk of depression during this period. Our findings suggest a need to provide behavioral and financial assistance to persons with fewer assets in the short run and a need to ensure that everyone has adequate assets to mitigate the mental health consequences of the COVID-19 pandemic in the long run.

1. Introduction

Assets, including financial (e.g., savings) and physical (e.g., housing ownership) assets, can equip individuals with stability that can be salutogenic (Elbogen et al., 2020; Ettman et al., 2020). Children growing up in wealthier families report lower psychological distress as young adults than children growing up in poorer families (Lê-Scherban et al., 2016). Additionally, housing disadvantage, broadly including housing instability, and/or mortgage delinquency, is associated with greater odds of probable depression (Singh et al., 2019).

Having fewer assets ahead of an economic crisis could result in

poorer behavioral and financial adjustments during the crisis, leading to further resource losses and impaired mental health (Hobfoll, 1998, 2011; Hou et al., 2018; Pearlin et al., 1981). Studies have elucidated the links among assets, behavioral outcomes, and mental health. Longitudinal data from a biennial household panel in Poland showed that insufficient savings were associated with more physical health problems (e.g., not sleeping well) and unhealthy behaviors such as alcohol consumption, smoking, and decreased physical activity (Białowolski et al., 2019). Having no home ownership was associated with reduced leisure time and physical activity among 1166 Australian women and 899 American residents (Cleland et al., 2012; Hannon III et al., 2012). In

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<https://doi.org/10.1016/j.jad.2022.07.040>

Received 22 April 2022; Received in revised form 18 June 2022; Accepted 18 July 2022

Available online 22 July 2022

0165-0327/© 2022 Published by Elsevier B.V.

another study involving residents of subsidized public housings, 50.6 % respondents reported unhealthy eating, tobacco use, or physical sedentariness (Harley et al., 2014). These maladaptive dietary and exercise patterns were probably attributable to restricted access to material resources (e.g., unaffordability of high-quality groceries) and social resources (e.g., impoverished social networks) (Fertig and Reingold, 2007; Kennedy-Hendricks et al., 2015). In a three-wave national cohort study in Australia ($n = 10,654$), a status change from housing affordability to unaffordability was associated with higher financial hardship and, in turn, higher levels of psychological distress (Singh et al., 2020).

Like other large-scale disasters, the COVID-19 pandemic precipitated an economic crisis worldwide that could negatively impact individuals' day-to-day life to varying degrees. Evidence from past public health disasters and economic crises suggests that these periods are associated with psychiatric morbidity and poorer psychosocial well-being (Marazziti et al., 2021; Mohammed et al., 2015; Mucci et al., 2016). Research conducted before and during the COVID-19 pandemic showed that lower assets were associated with greater odds of depressive symptoms both cross-sectionally and prospectively, controlling for the effects of socioeconomic status (Ettman et al., 2020; Ettman et al., 2022; Hou et al., 2021b). The acute economic shock in conjunction with lockdown policies could also result in higher risks of experiencing disrupted daily routines and financial hardship, and subsequently greater risk of depression among persons with fewer material resources (Kira et al., 2021; McGorry, 2020).

To the best of our knowledge, no study has explored the nature of associations among assets, persistent probable depression, and daily routine disruption and financial hardship during the COVID-19 pandemic. COVID-19 was first experienced as a large-scale disaster and subsequently as a financial crisis. This population-representative cohort study aimed to investigate (1) the prospective association of assets (i.e., low savings and no property ownership) in the acute phase of COVID-19 with persistent probable depression by 12-month follow-up, and (2) the mediating effects of daily routine disruptions in the acute phase and chronic financial hardship in the assets-depression association. We tested the following two hypotheses:

Hypothesis 1. Low assets (T1) will prospectively predict persistent probable depression (T1 to T2).

Hypothesis 2. The assets-depression link will be mediated by daily routine disruptions (T1) and financial hardship (T2).

2. Materials and methods

2.1. Respondents and procedure

This prospective study consisted of data from two timepoints, with Time 1 during the acute phase of COVID-19 from February to August 2020 (T1) and Time 2 at 12-month follow-up from March to August 2021 (T2). Upon obtaining the approvals from the Ethics Review Committee of The Education University of Hong Kong, the Centre for Communication and Public Opinion Survey of The Chinese University of Hong Kong and Hong Kong Public Opinion Research institute were contracted to conduct telephone surveys at T1. Random digit dialing was employed based on a dual-frame sampling approach with both landline and mobile phone numbers (50 % each) drawn from the databases released by the Hong Kong Communication Authority. Interviews were conducted with eligible respondents ($N = 8063$), who were (1) Hong Kong Chinese, (2) 15 years of age or older, and (3) Cantonese-speaking, from 2 pm to 10 pm on both weekdays and weekends. If multiple eligible members were identified in a successfully contacted household through landline phone calls, the one with the closest birthday to the interview date was selected. Further attempts were made for numbers with responses as “no answer”, “busy”, or “eligible respondent not at home”. At T2, these respondents were randomly selected and re-approached ($N = 1318$). Verbal/written consent was obtained prior to participation. The

sampling procedure of the current study closely followed that of other large-scale prospective cohort studies done locally (Cowling et al., 2020; Leung et al., 2017; Ni et al., 2017; Ni et al., 2020). Respondents received supermarket coupons with face value of HK\$100 (\approx US\$13) for compensation. The cooperation (i.e., completed/eligible individuals who were invited) and response (i.e., complied with acceptable standards) rates were 91.7 % and 76.5 % at T2 (see Supplementary material 1 for detailed sampling information).

2.2. Measures

2.2.1. Assets

Assets at T1 were indicated by a combination of savings (i.e., liquid asset) and home ownership (i.e., physical asset) (Ettman et al., 2020; Hou et al., 2021b). Respondents were asked to report their amount of savings in HK\$ (US\$1 \approx HK\$7.80) in seven categories (i.e., none, less than HK\$200,000, HK\$200,000–499,999, HK\$500,000–999,999, HK\$1,000,000–\$1,999,999; HK\$2,000,000–\$2,999,999; and HK\$3,000,000 or more), which included cash, money in bank accounts, stocks, bonds, mutual/insurance, and retirement funds. Savings were recoded into 0 = high (\geq HK\$200,000) and 1 = low ($<$ HK\$200,000) according to the Hong Kong population census data (Credit Suisse, 2019). Respondents also reported ownership of any houses/apartments (0 = yes, 1 = no). Assets were defined as 0 = high (i.e., high savings and/or home ownership) and 1 = low (i.e., low savings and no home ownership). A binary approach of assets has shown sensitivity in detecting probable depression and anxiety on a statistical level (Ettman et al., 2020; Hou et al., 2021b).

2.2.2. Daily routine disruptions

Primary and secondary routine disruptions at T1 were measured using two items from the Sustainability of Living Inventory (SOLI-2) (Hou et al., 2019; Hou et al., 2021c), one on primary routines (i.e., healthy eating and sleep) and one on secondary routines (i.e., socializing and leisure activities). Respondents indicated to what extent each type of routines was disrupted on an 11-point scale (0 = no disruptions, 10 = high level of disruptions) *over the past two weeks*. Mean scores were calculated for primary and secondary routine disruptions respectively, with higher scores indicating more severe disruptions (range = 0–10). The scores were then recoded into two categories (0 = low, 1 = high) following median split.

2.2.3. Financial hardship

Financial hardship at T2 was assessed using the 9-item Perceived Economic Strain Scale from the Economic Strain Model (Pearlin et al., 1981). Respondents were asked to report on difficulties they had in affording living necessities or optional accoutrements (e.g., food, clothing, furniture, leisure activities) *over the past six months* in eight items on a 4-point scale (1 = strongly disagree, 4 = strongly agree). Respondents also reported the amount of money left at the end of the month *over the past six months* on a 4-point scale (1 = more than enough money left over, 4 = not enough to make ends meet). A higher summed score indicated greater financial hardship (range = 9–36). The scores were then recoded into two categories (0 = low, 1 = high) following median split. Internal consistency was high ($\alpha = 0.89$) in the current administration.

2.2.4. Persistent probable depression

Depressive symptoms *over the past two weeks* were assessed at T1 and T2 using the Chinese version of the 9-item Patient Health Questionnaire (PHQ-9) on a 4-point scale (0 = not at all, 1 = on several days, 2 = on more than half of the days, 3 = nearly every day) (Yeung et al., 2008). The scale was used as a questionnaire. Higher summed scores indicated greater severity of depressive symptoms (range = 0–27). Scores of 0–9 were recoded into 0 and 1–27 into 1, with 1 indicating probable depression (Levis et al., 2019). Persistent probable depression was defined as the presence of probable depression at both T1 and T2 (Ettman et al., 2022). The PHQ-9 demonstrated good psychometric

properties among the Chinese population (Feng et al., 2016; Leung et al., 2020), and high internal consistency at both T1 ($\alpha = 0.83$) and T2 ($\alpha = 0.89$) administrations.

2.2.5. Demographics

Gender, age, marital status, education level, employment status, and monthly household income were recorded with a standardized performance at T1.

2.3. Statistical analysis

Missing data (<1 %) in all responses ($N = 1318$) were handled with multiple imputation. For individuals with high and low assets, descriptive data were presented on demographics, daily routine disruptions, financial hardship, and persistent probable depression. Prior to main analyses, the sample was weighted for gender, age, and education level with reference to population statistics (Census and Statistics Department, 2021).

Logistic regression analyses examined whether assets at T1, daily routine disruptions at T1, and financial hardship at T2 were positively associated with increased odds of persistent probable depression over T1 and T2. Three regression models were built. Models 1 and 2 predicted persistent probable depression, with Model 1 including demographics and assets whereas Model 2 with the addition of daily routine disruptions and financial hardship. Model 3 examined whether demographics and assets predicted primary routine disruptions, secondary routine disruptions, and financial hardship. Mediating effects of routine disruptions and financial hardship were estimated to exist between low assets and persistent probable depression if there were changes in magnitude and/or significance of odds ratios associated with assets from Model 1 to Model 2 and if the odds ratios associated with disruptions and hardship were significant in Model 3. Next, path analyses tested the mediating roles of daily routine disruptions and financial hardship between assets and persistent probable depression. Demographics (i.e., gender, age, and education level) were adjusted for as covariates. The path analyses were conducted using *Mplus* (Version 8.3). Weighted least square mean and variance adjusted (WLSMV) estimator was used. The performance of model was assessed with the root-mean-square error of approximation (RMSEA), standardized root mean squared error (SRMR), comparative fit index (CFI) and the Tucker-Lewis index (TLI).

3. Results

3.1. Respondents and prevalence

Descriptive statistics of the respondents ($N = 1318$) as stratified by assets are presented in Table 1. A total of 572 (43.40 %) respondents had low assets (i.e., low savings and no home ownership) at T1. The prevalence of persistent probable depression (i.e., PHQ-9 ≥ 10 at both T1 and T2) was significantly higher among respondents with low assets (14.51 %) than those with high assets (6.57 %). Compared with those with high assets, a significantly larger proportion of respondents with low assets reported higher primary routine disruptions (69.93 % vs. 49.46 %), secondary routine disruptions (57.69 % vs. 48.64 %), and financial hardship (69.93 % vs. 33.38 %).

3.2. Results addressing Hypothesis 1

Results from logistic regression showed that low assets were associated with 0.7 times (72.2 %) higher odds of persistent probable depression. In addition, persistent depression was 0.6 times (64.1 %) higher among females (vs. males), 6.1–7.2 times (614.0 %–716.8 %) higher among respondents aged 44 years or below (vs. 65 years or above), 1.1 times (110.5 %) higher among respondents with secondary education (vs. tertiary education or above), and 0.4–0.5 times (42.5 %–53.6 %) lower among respondents with monthly household income of

\$79,999 or below (vs. \$80,000 or above). The results are summarized in Table 2 (Model 1).

In order to rule out the potential confounding effects of age, propensity score matching was conducted and within the matched sample ($n = 740$), low assets remained a significant predictor of persistent probable depression (OR = 2.149, 95 % CI [1.224, 3.772], $p = .008$), on top of what was explained by the demographics ($\chi^2(1) = 7.318$, $p = .007$) (Supplementary material 2).

3.3. Results addressing Hypothesis 2

After adding daily routine disruptions and financial hardship into the model, primary routine disruptions, secondary routine disruptions, and financial hardship were associated with 2.2 times (224.6 %), 1.3 times (131.2 %), and 1.6 times (164.9 %) increased odds of persistent depression, respectively. The results are summarized in Table 2 (Model 2).

Logistic regressions revealed that low assets at T1 were associated with 0.4 times (37.3 %) increased odds of primary routine disruptions at T1, 0.3 times (32.5 %) increased odds of secondary routine disruptions at T1, and 2.6 times (255.0 %) increased odds of financial hardship at T2. Apart from assets, the odds of primary routine disruptions were positively predicted by age 44 years or below (vs. 65 years or above), non-married status (vs. married status), and monthly household income of \$39,999 or below (vs. \$80,000 or above). The odds of secondary routine disruptions were positively predicted by female gender (vs. male gender), age 54 years or below (vs. 65 years or above), and monthly household income of \$19,999 or below (vs. \$80,000 or above). The odds of financial hardship were positively predicted by female gender (vs. male gender), age 25–54 years (vs. 65 years or above), secondary education (vs. tertiary education or above), unemployed status (vs. employed status), and monthly household income of \$79,999 or below (vs. \$80,000 or above). The results are summarized in Table 3.

Fig. 1 presents the path model with mediating effects of daily routine disruptions and financial hardship on the association between assets and persistent probable depression. The model demonstrated satisfactory data-model fit (RMSEA = 0.019; 90 % CI [0.000, 0.054], SRMR = 0.041, CFI = 0.996, TLI = 0.971). The effect of T1 assets on persistent probable depression was fully mediated by T1 primary routine disruptions and T2 financial hardship. T1 secondary routine disruptions demonstrated an independent positive association with persistent probable depression despite the absence of a mediatory effect. Details on the direct and indirect effects are summarized in Table 4.

4. Discussion

The current study tested the prospective association of assets at the initial outbreak of COVID-19 in 2020 (T1) with persistent probable depression at 12-month follow-up in 2021 (T2) (Hypothesis 1) and the mediating effects of daily routine disruptions and financial hardship in the assets-depression association (Hypothesis 2) among a population-representative cohort. Consistent with Hypothesis 1, we found that there was a statistically significant association between pre-COVID-19 assets and persistent probable depression from 2020 to 2021. Partially consistent with Hypothesis 2, primary (but not secondary) routine disruptions and financial hardship mediated the positive association between T1 low assets and persistent probable depression from T1 to T2. Thus, having less control over one's daily routines or having financial strain may explain the relation between low assets and persistent probable depression.

4.1. Assets-depression link

Depression is one of the most prevalent mental health problems, particularly in countries and regions characterized by more economic difficulties (Marazziti et al., 2021) and income inequality (Furceri et al.,

Table 1
Descriptive information of current sample stratified by assets.

	High assets (n = 746) ^a	Low assets (n = 572) ^a	p-Value
Gender			.038*
Male	403 (54.02 %)	276 (48.25 %)	
Female	343 (45.98 %)	296 (51.75 %)	
Age			<.001***
65 or above	121 (16.22 %)	57 (9.97 %)	
55–64	123 (16.49 %)	39 (6.82 %)	
45–54	138 (18.50 %)	41 (7.17 %)	
35–44	158 (21.18 %)	78 (13.64 %)	
25–34	173 (23.19 %)	130 (22.73 %)	
15–24	33 (4.42 %)	227 (39.69 %)	
Marital status			<.001***
Married	477 (63.94 %)	163 (28.50 %)	
Single/divorced/widowed	269 (36.06 %)	409 (71.50 %)	
Education			.072
Tertiary or above	458 (61.39 %)	318 (55.59 %)	
Secondary	251 (33.65 %)	215 (37.59 %)	
Primary or below	37 (4.96 %)	39 (6.82 %)	
Employment			<.001***
Employed	513 (68.77 %)	267 (46.68 %)	
Unemployed/dependent	233 (31.23 %)	305 (53.32 %)	
Monthly household income ^b			<.001***
80,000 or above	187 (25.07 %)	54 (9.44 %)	
60,000–79,999	98 (13.14 %)	42 (7.34 %)	
40,000–59,999	197 (26.41 %)	104 (18.18 %)	
20,000–39,999	162 (21.72 %)	216 (37.76 %)	
19,999 or below	102 (13.67 %)	156 (27.27 %)	
Primary daily routine disruptions ^c			<.001***
Low	377 (50.54 %)	172 (30.07 %)	
High	369 (49.46 %)	400 (69.93 %)	
Secondary daily routine disruptions ^c			.001**
Low	383 (51.34 %)	242 (42.31 %)	
High	363 (48.64 %)	330 (57.69 %)	
Perceived financial hardship ^c			<.001***
Low	497 (66.62 %)	172 (30.07 %)	
High	249 (33.38 %)	400 (69.93 %)	
Persistent probable depression ^d			<.001***
No	697 (93.43 %)	489 (85.49 %)	
Yes	49 (6.57 %)	83 (14.51 %)	

* $p < .050$.

** $p < .010$.

*** $p < .001$.

^a Low assets was defined as low savings (less than HK\$200,000) and no home ownership, whereas high assets was defined as high savings (HK\$200,000 or more) and/or home ownership.

^b US\$1 \approx HK\$7.80.

^c Low vs. high groups were categorized based on median split.

^d Probable depression was defined as scores of 10 or above on the 9-item Patient Health Questionnaire (PHQ-9). Persistent probable depression was defined as scores of 10 or above on the PHQ-9 at both T1 and T2.

2020). Relatedly, this study was conducted in Hong Kong, one of the most expensive cities with high income inequality and property prices/rental expenses (Cheung, 2011). Most of the existing longitudinal work on assets and mental health has been conducted in the absence of major crises (Burgard et al., 2012; Lê-Scherban et al., 2016; Singh et al., 2019). Work done during COVID-19 is relatively scarce (Ettman et al., 2021; Ettman et al., 2022; Hou et al., 2021b), let alone studies outside a cross-sectional context (Ettman et al., 2022). The current study, conducted in the COVID-19 context, benefited from a prospective dataset to bridge this knowledge gap by demonstrating that in the face of acute public health and economic crises, there was a robust association between assets and depression, and that this association was mediated by daily routine disruptions and financial hardship.

Consistent with the Conservation of Resources (COR) Theory, assets can be considered as a buffer against the adverse impact of acute stressors. Assets are unevenly distributed by socioeconomic status (e.g., income, education level) and are less sensitive to momentary changes under major crises such as COVID-19 (Achdut and Refaeli, 2020; Allegrito, 2011; Carter et al., 2009; Hertz-Palmor et al., 2021). From a structural perspective (Panter-Brick and Eggerman, 2012), coping under

external stressors is largely subordinate to individuals' overall access to resources in the social environment, which is generally unfavorable for individuals from disadvantaged backgrounds (Hou et al., 2021a). Our results highlighted the prospective mental health consequences of assets, as low assets related to persistent depression over time, calling for both public health and macroeconomic policies. Because risk and protective factors accompanying the amount of assets could be largely transmitted inter-generationally (Ettman et al., 2020), its changes do not lie solely within the individual. Social policy-wise, safety net programs (e.g., cash transfer to free up existing financial resources) during and after large-scale disasters, such as COVID-19 and beyond, should be in place for vulnerable populations less equipped with pre-existing assets (Snowden, 2014).

4.2. Mechanisms underlying the assets-depression link

We found that the assets-depression link was mediated entirely by disruptions to primary routines of eating and sleep in the acute phase (Hou et al., 2021c) as well as the chronic financial hardship, denoting desired needs unmet by actual economic abilities (Frankham et al.,

Table 2

Logistic regression examining the associations of assets, daily routine disruptions, perceived financial hardship with persistent probable depression (Models 1 and 2).

Variable	Persistent probable depression ^a	
	Model 1	Model 2
Gender		
Male	1	1
Female	1.641 [1.249, 2.157]***	1.416 [1.065, 1.882]*
Age		
65 or above	1	1
55–64	2.208 [0.370, 13.181]	1.865 [0.311, 11.194]
45–54	3.503 [0.640, 19.164]	2.556 [0.463, 14.099]
35–44	8.168 [1.635, 40.803]**	5.553 [1.113, 27.698]*
25–34	7.384 [1.476, 36.934]*	4.291 [0.858, 21.467]
15–24	7.140 [1.427, 35.717]*	4.287 [0.852, 21.578]
Marital status		
Married	1	1
Single/divorced/widowed	1.467 [0.963, 2.233]	1.347 [0.872, 2.083]
Education		
Tertiary or above	1	1
Secondary	2.105 [1.443, 3.072]***	1.954 [1.313, 2.909]***
Primary or below	5.430 [0.715, 41.214]	3.838 [0.481, 30.611]
Employment		
Employed	1	1
Dependent/unemployed	0.813 [0.571, 1.158]	0.744 [0.512, 1.080]
Monthly household income		
\$80,000 or above	1	1
\$60,000–\$79,999	0.474 [0.286, 0.785]**	0.422 [0.250, 0.712]**
\$40,000–\$59,999	0.464 [0.311, 0.693]***	0.379 [0.249, 0.578]***
\$20,000–\$39,999	0.575 [0.392, 0.843]**	0.420 [0.279, 0.634]***
\$19,999 or below	0.490 [0.285, 0.842]**	0.304 [0.172, 0.538]***
Assets ^b		
High	1	1
Low	1.722 [1.215, 2.440]**	1.244 [0.860, 1.802]
Primary daily routine disruptions ^c		
Low	–	1
High	–	3.246 [2.114, 4.984]***
Secondary daily routine disruptions ^c		
Low	–	1
High	–	2.312 [1.657, 3.227]***
Perceived financial hardship ^c		
Low	–	1
High	–	2.649 [1.894, 3.706]***

Notes. The sample was weighted for gender, age, and education.

- * $p < .050$.
- ** $p < .010$.
- *** $p < .001$.

^a Probable depression was defined as scores of 10 or above on the 9-item Patient Health Questionnaire (PHQ-9). Persistent probable depression was defined as scores of 10 or above on the PHQ-9 at both T1 and T2.

^b Low assets was defined as low savings (less than HK\$200,000) and no home ownership, whereas high assets was defined as high savings (HK\$200,000 or more) and/or home ownership.

^c Low vs. high groups were categorized based on median split.

2020; Szanton et al., 2010), in the year following the acute phase. Individuals equipped with less financial resources before the pandemic were more likely to experience immediate living difficulties and subsequent insufficient economic abilities to meet the needs in day-to-day living, which could be seen as the context for persistent mental health problems in the long term. While policy changes targeting assets-based inequality are pressing, these are difficult to implement and take time. Therefore, recognizing this time lag, the mediating pathways through which assets impact mental health are of practical value particularly, because they represent modifiable intervention targets in the short term.

Regarding the mediating pathway through disrupted primary routines, our results agree with previous evidence which showed that disrupted daily schedules or changes in everyday activities predicted increased odds of probable depression and anxiety (Hou et al., 2021c; Lai et al., 2021; Lau et al., 2021). Disrupted primary or secondary routines and behavioral manifestations of psychiatric conditions are distinctly different because the former concerned a lack of *regularity*

(Hou et al., 2018; Hou et al., 2019) whereas the latter *dysfunction* (Otte et al., 2016). However, most previous studies examined daily routines as a predictor of mental health and rarely considered the mediating effects of routine disruptions on the economic determination of depression (Lai et al., 2020; Lai et al., 2021). Our results were also partially consistent with previous evidence on the behavioral consequences of inadequate assets. For example, low savings and no home ownership have been shown to be associated with reduced physical activity and/or compromised sleep quality (Białowolski et al., 2019; Cleland et al., 2012; Hannon III et al., 2012). Residents in public housing reported reduced exercises and unhealthy dietary habits (Fertig and Reingold, 2007; Harley et al., 2014; Kennedy-Hendricks et al., 2015), relative to less disadvantaged counterparts. Most importantly, it is particularly worth noting that our results uniquely showed that the *immediate* disruptions to primary routines (healthy eating and sleep) during the outbreak of COVID-19 prospectively predicted *persistent* probable depression in a year's time. Our results suggest that the enrichment of secondary

Table 3
Multivariate multiple logistic regression examining the associations of assets with daily routine disruptions and perceived financial hardship (Model 3).

Variable	Primary daily routine disruptions ^a	Secondary daily routine disruptions ^a	Perceived financial hardship ^a
Gender			
Male	1	1	1
Female	0.970 [0.806, 1.167]	1.620 [1.364, 1.924]***	1.461 [1.210, 1.763]***
Age			
65 or above	1	1	1
55–64	1.317 [0.746, 2.325]	1.671 [0.942, 2.963]	1.376 [0.740, 2.559]
45–54	1.315 [0.762, 2.269]	1.912 [1.107, 3.302]*	1.885 [1.046, 3.396]*
35–44	2.935 [1.755, 4.908]***	2.335 [1.395, 3.907]**	1.891 [1.088, 3.288]*
25–34	3.901 [2.329, 6.532]***	2.979 [1.779, 4.987]***	2.233 [1.289, 3.871]**
15–24	4.295 [2.543, 7.254]***	2.476 [1.471, 4.167]***	1.686 [0.969, 2.932]
Marital status			
Married	1	1	1
Single/divorced/widowed	1.340 [1.044, 1.720]*	0.838 [0.656, 1.071]	1.217 [0.930, 1.593]
Education			
Tertiary or above	1	1	1
Secondary	1.155 [0.882, 1.512]	1.169 [0.912, 1.500]	1.774 [1.344, 2.341]***
Primary or below	1.797 [0.581, 5.557]	2.205 [0.695, 6.992]	1.965 [0.574, 6.725]
Employment			
Employed	1	1	1
Dependent/unemployed	1.090 [0.854, 1.392]	0.836 [0.668, 1.046]	1.654 [1.302, 2.101]***
Monthly household income			
\$80,000 or above	1	1	1
\$60,000–\$79,999	0.932 [0.685, 1.268]	0.939 [0.699, 1.262]	1.606 [1.155, 2.233]**
\$40,000–\$59,999	1.283 [0.988, 1.666]	1.089 [0.851, 1.392]	1.530 [1.163, 2.013]**
\$20,000–\$39,999	1.327 [1.011, 1.741]*	0.953 [0.740, 1.228]	2.578 [1.950, 3.409]***
\$19,999 or below	1.570 [1.079, 2.284]*	1.515 [1.070, 2.145]*	2.837 [1.943, 4.142]***
Assets ^b			
High	1	1	1
Low	1.373 [1.095, 1.722]**	1.325 [1.069, 1.642]*	3.550 [2.829, 4.453]***

Notes. The sample was weighted for gender, age, and education.

* $p < .050$.

** $p < .010$.

*** $p < .001$.

^a Outcomes were binary variables (based on median split).

^b Low assets was defined as low savings (less than HK\$200,000) and no home ownership, whereas high assets was defined as high savings (HK\$200,000 or more) and/or home ownership.

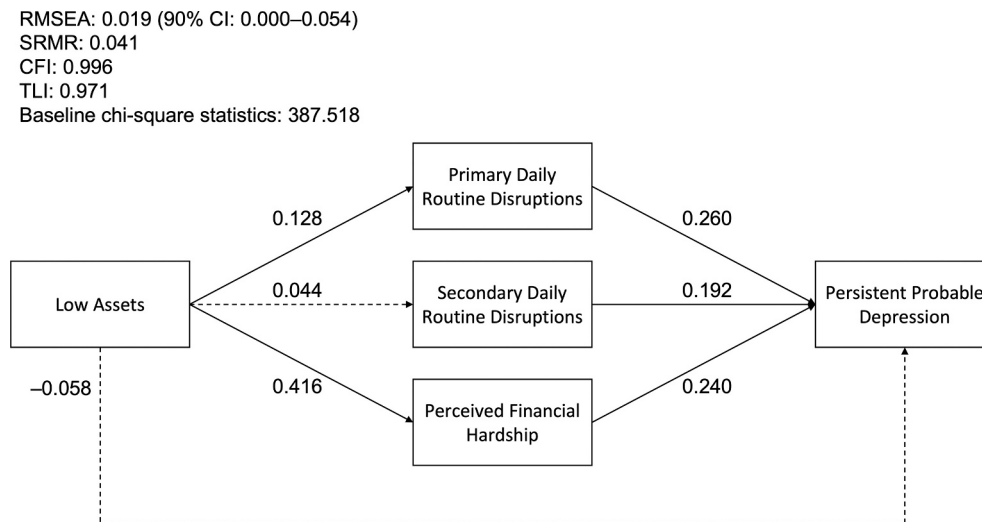


Fig. 1. Path model showing the mediation processes of assets on persistent probable depression through daily routine disruptions and perceived financial hardship. Notes. The sample was weighted for gender, age, and education level. Demographics variables (i.e., gender, age, and education level) were additionally adjusted for in the path model as covariates. The full figure including demographics covariates is available from the corresponding author.

Table 4

Path analyses examining the association of assets with persistent probable depression, mediated by daily routine disruptions and perceived financial hardship.

Outcome	Direct/indirect effects	Direct/indirect effect β [95 % CI]
Persistent probable depression ^a	Low assets	−0.058 [−0.193, 0.078]
	Low assets → Primary daily routine disruptions ^b	0.033 [0.001, 0.065]*
	Low assets → Secondary daily routine disruptions ^b	0.009 [−0.010, 0.028]
	Low assets → Perceived financial hardship ^b	0.100 [0.026, 0.174]**

Notes. The sample was weighted for gender, age, and education.

* $p < .050$.** $p < .010$.^a Probable depression was defined as scores of 10 or above on the 9-item Patient Health Questionnaire (PHQ-9). Persistent probable depression was defined as scores of 10 or above on the PHQ-9 at both T1 and T2.^b Mediators were binary variables (based on median split).

routines (socializing and leisure activities) may protect mental health against COVID-19-related stressors across differing socioeconomic and financial statuses over time, given the results that disruptions to secondary routines were fairly minimal as a result of low assets, whereas at the same time it displayed an independent prospective association with persistent probable depression. This agrees with previous evidence where secondary routines of social activities and hobbies were positively associated with mood (Kornilaki, 2022; Zubek et al., 2022).

While COVID-19 was initially considered as a public health crisis, it has gradually become clear that it is a much more complex crisis that entails economic challenges on the global and national levels. At the individual level this can result in difficulties among vulnerable individuals with fewer resources as financial buffers. Household financial strain during COVID-19 has been found to be associated with depressive symptoms among caregivers of children (Fitzpatrick et al., 2021). Prolonged exposure to financial hardship during the current pandemic prospectively predicted psychological distress among a national panel of Canadian respondents (Bierman et al., 2021). The positive association of financial hardship with probable depression independent of low assets suggests that the subjective experience of deprived financial resources in relation to one's desired needs could be one of the significant determinants of poorer mental health (Frankham et al., 2020; Pearlin et al., 1981). Consistent with this finding, Financial Strain Theory suggests that “people are not simply depressed by an event, but also by the more enduring strains to which the event contributes” (Pearlin et al., 1981, p. 345). Mental illnesses occur when objective inequalities are transformed into subjective perceptions of one's social standings and financial health (Demakakos et al., 2008). In the current study, financial hardship reflected the challenges to pay a range of living necessities in day-to-day living in the year 2021 following the acute phase of COVID-19 in 2020. The deficit in everyday financial resources could manifest in persistent probable depression even when the health-related threat of COVID-19 dissipates.

4.3. Limitations and implications

The present study has some limitations. First, the two mediating pathways of daily routine disruptions and financial hardship could be interrelated in ways not fully considered here (Allen et al., 2014; Harley et al., 2014). For example, one study showed that disrupted sleep routines due to long working hours could predict more depressive symptoms, only among individuals experiencing financial strain (Peltz et al., 2021). Future studies would potentially benefit through involving three or more waves, further examining the reciprocity between behavioral and financial difficulties. Second, financial hardship was not measured at T1 and thus whether it confounded the current findings is unknown. Third, depression was assessed with a self-report measure instead of formal clinical diagnosis. However, the PHQ-9 is a well validated tool, mitigating this concern. Relatedly, we would like to caution that persistent probable depression in the current study should not be

understood as equivalent to diagnoses of chronic depression, dysthymia, or alike. Operationalization of persistent probable depression in the current study was defined as clinically significant depressive symptoms across the two timepoints of assessment following previous approaches (Ettman et al., 2022). Fourth, further consideration of other mental health outcomes (e.g., probable anxiety) would have provided a more complete picture.

Notwithstanding the above limitations, this study benefited from a prospective dataset on a relatively large population-representative sample. Our findings extend previous research on the assets-depression link by considering the direct vs. indirect nature of this association, as well as disentangling the underlying mechanisms. These highlight the importance of tackling structural inequality and provide an evidence base for developing cost-effective intervention and education programs to cultivate people's behavioral and financial coping skills, with the shared ultimate goal of enhancing population mental health during large-scale disasters.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2022.07.040>.

Role of the funding source

This work was supported by Research Grants Council, University Grants Committee, Hong Kong SAR, China [grant numbers C7069-19 GF (W.K.H. and T.M.C.L.) and 18600320 (W.K.H., T.M.C.L., and A.L.C.F.)]. The funding source had no role in any process of our study.

CRedit authorship contribution statement

Tiffany Junchen Tao: Conceptualization, Data curation, Formal analysis, Writing – Original draft, Writing – Review & editing; **Tatia Mei Chun Lee:** Writing – Review & editing, Funding acquisition; **Annis Lai Chu Fung:** Writing – Review & editing, Funding acquisition; **Tsz Wai Li:** Methodology, Investigation, Data curation, Writing – Review & editing; **Catherine K. Ettman:** Writing – Review & editing; **Sandro Galea:** Conceptualization, Writing – Review & editing; **Wai Kai Hou:** Conceptualization, Methodology, Formal analysis, Supervision, Writing – Original draft, Writing – Review & editing, Funding acquisition.

Conflict of interest

None.

Acknowledgements

We would like to thank all the respondents who participated in this study. We would also like to thank Ms. Po Lam Ho, Mr. Ernest Tsun Fung Yeung, and all other individuals who made significant contributions to the data collection.

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