

# BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email [info.bmjopen@bmj.com](mailto:info.bmjopen@bmj.com)

# BMJ Open

## Characteristics and well-being of urban informal home care providers during COVID-19 pandemic: a population-based study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-041191
Article Type:	Original research
Date Submitted by the Author:	04-Jun-2020
Complete List of Authors:	<p>Chan, Emily; The Chinese University of Hong Kong, JC School of Public Health and Primary Care; University of Oxford, Nuffield Department of Medicine</p> <p>Lo, Eugene; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Huang, Zhe; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Kim, Jean ; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Hung, Heidi; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Hung, Kevin KC; Chinese University of Hong Kong, Accident and Emergency Medicine Academic Unit</p> <p>Wong, Eliza LY; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Wong, Samuel; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Gobat, Nina; University of Oxford, Nuffield Department of Medicine</p>
Keywords:	Public health < INFECTIOUS DISEASES, PRIMARY CARE, PUBLIC HEALTH

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

# Characteristics and well-being of urban informal home care providers during COVID-19 pandemic: a population-based study

Emily Ying Yang Chan<sup>1,2,3\*</sup>, Eugene Siu Kai Lo<sup>1,3</sup>, Zhe Huang<sup>1,3</sup>, Jean H Kim<sup>3</sup>, Heidi Hung<sup>1,3</sup>, Kevin Kei Ching Hung<sup>1,4</sup>, Eliza Lai Yi Wong<sup>3</sup>, Samuel Yeung Shan Wong<sup>3</sup>, Nina Gobat<sup>6</sup>

<sup>1</sup> Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), The Chinese University of Hong Kong, Hong Kong, China; emily.chan@cuhk.edu.hk; euglisk@cuhk.edu.hk; huangzhe@cuhk.edu.hk

<sup>2</sup> Nuffield Department of Medicine, University of Oxford, Oxford OX37BN, UK

<sup>3</sup> JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, China;

<sup>4</sup> Accident & Emergency Medicine Academic Unit, The Chinese University of Hong Kong, Prince of Wales Hospital, Hong Kong SAR, China; kevin.hung@cuhk.edu.hk

<sup>5</sup> Centre for Health Systems and Policy Research, JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, China

<sup>6</sup> Primary Health Care, Nuffield Department of Medicine, University of Oxford. nina.gobat@phc.ac.ox.uk

\* Correspondence: emily.chan@cuhk.edu.hk; Tel.: +852-2252-8702

## ABSTRACT

### Objectives

Globally, the COVID-19 pandemic has overwhelmed many health care systems and individuals are unable to access routine clinical care during lockdowns. Informal home care, care provided by non-healthcare professionals, increases the community's health care surge capacity during pandemics. There is, however, limited research about the characteristics of informal home care providers and the challenges they face during such public health emergencies.

### Design

A random, cross-sectional, population-based telephone survey study was conducted to examine patterns of home care, characteristics of informal home care providers and the challenges of these care providers during this pandemic.

### Setting

Data were collected from 22 March to 1 April 2020 in Hong Kong, China.

### Participants

A population representative study sample of Chinese-speaking adults (n=765) was interviewed.

### Primary and secondary outcome measures

The study examined the characteristics of informal home care providers, and the characteristics and health care requirements of the care recipients. The study also examined providers' self-perceived knowledge to provide routine home care as well as COVID-19 risk reduction care. Respondents were asked about mental health related to COVID-19.

### Results

Of the respondents, 25.1% of 765 provided informal home care during the studied COVID-19

1  
2  
3 pandemic period. Of informal home care providers, 18.4% of respondents took leave from  
4 school/work during the epidemic to provide care that included fragile elderly and small children.  
5 These care providers tended to be younger-aged, female, and housewives. Approximately half of  
6 caregivers reported additional mental strain and 37.2 % reported of challenges in daily living  
7 during epidemic. Although most informal home care providers felt competent to provide routine  
8 care, 49.5% felt inadequately prepared to cope with the additional health risks of COVID-19.  
9  
10

### 11 Conclusion

12 During public health emergencies, heavy reliance on informal home health care providers  
13 necessitates better understanding of their specific needs and increased government services to  
14 support informal home care.  
15

16  
17 **Keywords:** Informal home care, health and well-being, COVID 19, Urban, Asia, Hong Kong  
18  
19

20 **Abstract word count: 300**  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

### Strengths and limitation of this study

In a city affected in the early stages of the COVID-19 pandemic, this study was the first to highlight the impact and added burden of care experienced by informal home care providers among the general population.

This telephone-based study was conducted during the peak period of COVID-19 epidemic in Hong Kong, so the citizen would be more compliant and attentive to the telephone survey as they were encouraged to stay at home for work or daily activity.

The cross-sectional design cannot draw a conclusion on any cause-effect relationship.

this study might subject to reporting bias since data were self-reported, and data from non-respondents could not be obtained.

### INTRODUCTION

Home care is regarded as one of the major care models to address medical needs for patients and vulnerable populations during COVID-19 pandemic<sup>1</sup>. As described by the World Health Organization (WHO)<sup>2</sup>, home care aims to provide high quality and cost-effective care to individuals that will enable them to maintain their independence and the highest possible quality of life. While formal home care providers are usually remunerated workers from medical authorities or registered organizations, informal home care providers are usually family members or others who provide unpaid care to those in need<sup>3</sup>. The typical profile of individuals who require home care are patients with chronic diseases or mental conditions, individuals with disabilities, young children, the elderly and other vulnerable individuals who live alone. Up to the present, the published literature has mainly examined the quality of life of older adults, the care recipients, the mental health of the care providers<sup>4-6</sup> and experience of informal home care providers under non-emergency health situations<sup>7,8</sup>.

During the COVID-19 pandemic, in an attempt to reduce the surge of patients requiring hospital care, many countries have implemented epidemic control measures<sup>9</sup> to limit activities outside the home such as closure of non-essential services. Moreover, countries have relied heavily on home quarantine for suspected COVID-19 patients with mild-symptoms in order to maintain resilience of the national health system<sup>1,9,10</sup>. In Hong Kong, in conjunction with prohibitions on mass gatherings, closure of recreational centers, schools and community services<sup>11,12</sup>, a mandatory 14-days quarantine was issued for those who entered into Hong Kong from outside its borders<sup>13</sup>. This resulted in 13,649 individuals under compulsory home quarantine from 13 Mar to 26 Mar 2020<sup>14</sup>. There have been no published studies of informal care providers during extreme events or during population-level health emergencies. Hence, the impacts on informal home care providers from the closure of community services and limited access to healthcare services during the COVID-19 are yet unknown.

According to the Hong Kong 2016 By-census, one-fourth of households had children aged under 15 while and one-third household reported having at least one elderly household member<sup>15</sup>.

1  
2  
3 Combined, these households accounted for 27.2% of the whole Hong Kong population. The likely  
4 heavy reliance on informal home care during a pandemic emergency in Hong Kong allows  
5 examination of the prevalence and special needs of informal home care providers. This study  
6 aimed to identify informal home care patterns, characteristics of informal home care providers and  
7 their challenges during the COVID-19 epidemic. The study also seeks to examine the knowledge  
8 levels and level of preparation for the home quarantine among these care providers and the  
9 recipients of their care in Hong Kong.  
10  
11

## 12 **METHODS**

### 13 **Study design and study population**

14  
15  
16  
17 A cross-sectional, population-based telephone survey was conducted from 22 March to 1 April  
18 2020 during the peak of local COVID-19 pandemic. The computerized Random Digit Dialing  
19 (RDD) method was used for each of Hong Kong's 18 districts to randomly select a representative  
20 sample. The survey methods and the sample size estimation have been previously detailed<sup>16</sup>. It  
21 was designed on the basis of literature review and previous research experience<sup>17-20</sup>. The study  
22 only includes respondents who were 18 years old or older, and speak Cantonese.  
23  
24

### 25 **The study instruments**

26  
27 A self-reported, semi-structured Chinese questionnaire with 141 questions was used for data  
28 collection<sup>16</sup>. Care providers were identified through one of the questions in the questionnaire "Do  
29 you currently need to look after member(s) of your family and relatives' daily needs (like your  
30 children/parents) during COVID-19 epidemic?". Besides the experience and situations of their  
31 care duties during the COVID-19, the characteristics of the care recipients under their care were  
32 also investigated. Care recipients' age, sex, relationship with the care provider, the reason for the  
33 receiving care and their dependency were recorded. Care providers were also asked if they were  
34 the primary care providers for their recipients (defined as having the major responsibility in  
35 caregiving duties) and if their care recipient was dependent on them (defined as inability to  
36 maintain activities of daily living without caregiver assistance). All self-reported home care  
37 providers in this study were confirmed to be informal care provider.  
38  
39  
40

41 Care providers were asked if they felt that they possessed sufficient knowledge about routine care  
42 and COVID-19 risk mitigation. A 5-point Likert scale was used to assess physical, mental, social  
43 and other related health impact (ranging from 1= no impact to 5= maximum impact). Respondents  
44 were asked about their home care experience, risks perception, household capacity to provide care  
45 and home care challenges that they experienced. The instrument also asked about knowledge of  
46 infection control during a home quarantine. Specifically, the respondents were asked about their  
47 knowledge of infection control in home context such as *the ratio of bleach solution for cleaning*  
48 *(1:99 ratio for normal cleaning and 1:49 for cleaning vomit, excreta or secretion<sup>21</sup>), the*  
49 *recommended distance for with the quarantine subjects (at least 1 meter<sup>21</sup>).*  
50  
51

### 52 **Statistical analysis**

53  
54 Descriptive statistics of the study sample were presented with chi-square tests to examine  
55 comparability of the study sample with the Hong Kong general census population<sup>22</sup>. Socio-  
56  
57  
58  
59  
60

1  
2  
3 demographic pattern analyses of respondents who might have care-providing responsibilities, the  
4 home care recipients, and the context of care provision during the COVID-19, were conducted.  
5 Chi-square test was conducted for comparing the perception toward COVID-19 between care  
6 provider and non-care provider subjects. Multivariable logistic regression analysis was conducted  
7 to compare the sociodemographic predictors between care providers and non-care providers. In  
8 addition, logistic regression analysis was conducted to understand how the socio-demographic of  
9 the care provider and their care responsibilities may affect their daily living. For both multivariable  
10 logistic regressions, the first step involved bivariate analyses (chi-square test or independent t-  
11 test). Explanatory variables whose significance was  $<0.10$  were entered as candidate variables into  
12 a multivariable logistic model. Chi-square tests were then conducted between the care providers  
13 who believe they possess sufficient or insufficient knowledge in providing routine care and  
14 COVID-19 risk mitigation. Missing values will be excluded in the data analysis. No sensitivity  
15 analysis was conducted. The level of significance of statistical test was 0.05. All statistical analyses  
16 was conducted using IBM SPSS 21 for Windows<sup>23</sup>.  
17  
18  
19

### 20 **Patient and public involvement**

21 The design, or conduct, or reporting, or dissemination plans of our research were done without  
22 patient or the public involvement.  
23  
24

## 25 **RESULTS**

26  
27 Final study sample consisted of 765 respondents (44.0% response rate) and was comparable with  
28 the population data in Hong Kong By-census 2016. Of the 765 participants, 53.5% (n=409) were  
29 women, 18.7% (n=143) were aged 64 and above, and 60.2% (n=459) were currently married.  
30 Information about the respondents and the recruitment process were detailed in a previous study  
31 in the same series<sup>16</sup>.  
32  
33

### 34 **Characteristics of the home care recipients (N=345)**

35  
36 The study sample consisted of 192 care providers, who reported that they needed to provide care  
37 for 345 care recipients. Among these home care recipients, children represented 55.2% (being  
38 taken care of by parents), parents and parent-in-law represented 21.4% (being taken care of by  
39 children and children-in-law), while spouses accounted for 17.8%. (*Figure 1a*). As cited by the  
40 informal care providers, the main reasons for recipients' need of home care was due to extreme  
41 age (24.2%), isolation requirements due to COVID-19 epidemic (23.5%), recipient's chronic  
42 medical conditions (8.0%) and physical activities limitation (4.3%). Over half (53.8%) of home  
43 care recipients in the sample were considered as completely care dependent. Figure 1b showed  
44 most of the dependent care recipient were aged 0-18 and aged 75 or above (chi-square p-value:  
45  $p<0.001$ ). Gender difference was not significant between dependent and non-dependent care  
46 recipient.  
47  
48  
49  
50

### 51 **Who were the informal care provider during the COVID-19? (n=192)**

52  
53 In our study sample, one-quarter of respondents reported to have undertaken care responsibilities  
54 during the COVID-19 epidemic (Table 1). Notably, about 83.7% of informal home care providers  
55 were the primary home care providers and informal home care providers were predominantly  
56  
57  
58  
59  
60



female (67%, 129/192). Of informal home care providers, 44.8% were middle aged (45-64 years age), 38% were (73/192) aged 18-44 and 17.2% were aged 65 or above. Although full-time housewives represented nearly one-quarter of the informal care providers while 13.4% were unemployed or retired, more than 50% of informal home care providers were concurrently employed (44% were white collar employees). Multivariable logistic regression results indicated that *younger adults, female, married, housewives* were more likely to be informal home care providers during COVID 19 (Table 1)

Table 1. Factors associated with having informal home care responsibilities during the COVID-19 pandemic in Hong Kong (N=765)

N	Non-care provider (N=573)	Care provider (N=192)	p	AOR (95% Confident Interval)	p
Age			<0.001*		
18-24	12.0%	1.0%		Ref.	
25-44	30.9%	37.0%		5.34 (1.01 – 28.37)	0.049*
45-64	37.9%	44.8%		4.09 (0.76 – 22.14)	0.102
65 or more	19.2%	17.2%		3.63 (0.63 – 20.85)	0.148
Gender			<0.001*		
Male	51.1%	32.8%		Ref.	
Female	48.9%	67.2%		1.90 (1.29 – 2.82)	0.001*
Education attainment			0.125		
Primary level or below	8.1%	7.8%			
Secondary level	41.2%	49.5%			
Tertiary level	50.7%	42.7%			
Housing			0.370		
Public housing	28.4%	24.5%			
Subsidized housing	14.9%	12.0%			
Private housing	55.3%	62.5%			
Others	1.4%	1.0%			
Housing size			0.499		
Small (350ft or below)	22.1%	18.4%			
Medium (351 ft- 800ft)	63.0%	67.6%			
Large (801 ft. or above)	15.0%	14.0%			
Chronic disease?			0.155		
No	82.7%	78.1%			
Yes	17.3%	21.9%			
Marital status			<0.001*		
Currently unmarried	44.8%	25.0%		Ref.	
Currently married	55.2%	75.0%		2.20 (1.45 – 3.35)	<0.001*
Employment			<0.001*		
White collar	45.5%	44.4%		Ref.	
Blue collar	16.4%	18.7%		1.43 (0.88 – 2.32)	0.144

Housewives	8.8%	23.0%		1.89 (1.08 – 3.31)	0.026*
Students	8.1%	0.5%		0.38 (0.04 – 3.88)	0.412
Unemployed and retired	21.2%	13.4%		0.80 (0.43 – 1.50)	0.488
Household income			0.335		
<7999	10.0%	6.7%			
8000 – 19999	14.5%	12.8%			
20000 – 39999	25.2%	30.7%			
40000 or more	50.3%	49.7%			
*p<0.05 In the multivariable logistic regression, there were 2 missing values in <i>marital status</i> , and 11 missing values in <i>employment</i> .					

Nearly one in five of informal home care providers reported that they had to take personal leave from work or school to take care of their families. Informal home care providers who had taken personal leave were significantly more likely to be younger age (18-44 years of age), and were significantly more likely to have 2 or more dependent care recipients (chi-square p-value: <0.05). Although care provider's underlying chronic disease status, education attainment, housing types, and household income were not statistically significant.

The association between income levels and informal home care duties was statistically insignificant (chi-square p-value: >0.05). Yet, analysis showed home care providers from lower income subgroups (HKD 8000 – 19999) tended to have to be responsible for more than one care recipient when compare with the higher income counterparts (Figure 2). In addition, Female was found to be the predominant gender to have taken up the primary informal care provider's role (73.4%, chi-square p-value: <0.001).

\*There are 13 missing values in household income.

More than half of the informal home care providers were responsible for caring for more than one individual with nearly 20% (36/192) of respondents reporting that they needed to provide care to 3 or more household members. Of note, 64.7% care providers reported that there was at least 1 dependent care recipient under their caring duties; 32.3% and 47.6% care providers reported to be giving care to elderly family members (aged 65 or above) and children under the age of 18 or younger, respectively. Moreover, nearly 28% of households providing informal home care for fragile elderly while 7.4% had people with disabilities.

A statistically significant age association was found between care provider and recipient. Elderly care providers were more likely to provide home care to those 65 or older (p<0.05), while younger (aged 18-44) tend to provide care for aged 18 or younger care recipient (p<0.05). Younger care providers (aged 18-44) were more likely to provide home care to 2 or more dependent care recipient (31.4%) than the older age group (age 45-64: 21.0%, age 65 or above: 12.1%, p-value: 0.018). Meanwhile, other socio-demographic factor like gender, Education attainment, housing factors of the care provider were not statistically significant. About 11.9% care providers reported they had family members requiring care mainly due to their chronic disease condition. Non-

married care providers (26.7%; married: 7.1%) were more likely to provide care for household members with chronic disease ( $p<0.001$ ).

### Physical, mental and social health of informal care providers during COVID-19

Among the informal care provider, nearly 22% reported having an underlying chronic medical condition themselves but this proportion did not significantly differ from the non-informal care providers (17.3%) (Table 1). The perception of COVID-19's impact between provider and non-care provider is shown in Table 2. Those providing informal home care showed no significant differences in self-reported impacts on physical health, social life, and financial status, while significant difference was found for self-report impact of mental health status when compared between people with and without home care duties.

Table 2. Differences in perception between care provider and non-caregiver provider

	Non-care provider (N=573)	Care provider (N=192)	P
<b>Self-reported COVID-19 impact on physical, mental, social well-being</b>			
Believed COVID-19 had large effect on their physical health	50.3%	55.7%	0.190
Believed COVID-19 had large effect on their mental health	44.5%	53.6%	0.028*
Believed COVID-19 had large effect on their social life	70.7%	76.0%	0.152
Believed COVID-19 had large effect on their financial status	32.6%	35.4%	0.479
Believed COVID-19 had large effect on the Hong Kong	94.6%	93.8%	0.662
* $p<0.05$			

Notably, 53.9% reported that they had experienced additional strain in their care providers' duties. The most common cited reasons for additional strains included COVID-19 health risk concern (40.2%), increased time spent with care recipient (27.5%), and more things need to take care of during the pandemic (21.6%). For changes of community services (e.g. day care center) utilization that facilitated pre-COVID 19 care, 41 subjects reported to have used community services regularly and among them 39% had stopped or decreased the use of the services due to the epidemic.

Of the informal home care providers, 37.2% reported that their daily lives became more challenging due to the need to care for their family during COVID-19 epidemic. Multivariable regression analysis, however, showed that these perceptions were not associated with age, sex and education attainment nor the number of care recipient. But providers who were having a dependent care recipient(s), and individuals having to take personal leave reported significantly increased difficulty in daily living ( $p<0.001$ ) (Table S1 in supplementary file).

## Care provider's perceived knowledge sufficiency

While nearly 90% of these home care providers believed that they had sufficient knowledge to provide routine care, only 50.5% believed that they had sufficient knowledge to manage the additional risk brought on by COVID-19 (Table S2 in supplementary file). Although various sociodemographic factors and care recipient characteristics were associated with care providers' perceived adequacy of knowledge for providing routine home care, there was no statistically significant difference for perceived adequacy of knowledge in COVID-19 risk mitigation by any sociodemographic or care recipient factors.

## Home environment to facilitate home care and household COVID-19 risk control

Among the study population (n=765), only 32 subjects (4.2%) reported to have undergone home-quarantine/isolation during the COVID-19 epidemic. Among these subgroups, 23 (71.9%) took voluntary-based/self-imposed home isolation while 9 (28.1%) had to be home-bound due to government compulsory home isolation requirements. Reasons cited for quarantine due to recent travel abroad (41.9%) and in close contacts with confirmed patients (19.4%). Among the care providers, about 3.6% (7/192) reported that they had applied quarantine. Subjects were also asked about their preparation adequacy for potential home quarantine for 2 weeks. More than half of the subjects claimed they had sufficient masks, detergent, disposable gloves and sufficient independent rooms for isolation use. For the general household preparation, more than 80% participants have prepared alcohol rub, sufficient medicine and food and storage after COVID-19 epidemic started (Table 3).

Table 3. Self-reported household items for COVID-19 control during the epidemic (N=765)

	N (%)
Household preparation items for potential quarantine	
Masks	86.8%
Detergent	92.9%
Disposable gloves	51.9%
Sufficient independent room for isolation use	65.2%
General household preparation items	
Alcohol rub	95.2%
Basic medicine (for fevers and common cold)	92.4%
Food and water storage sufficient for 1 day	87.2%
Chronic disease medication enough for 1 week (N=241)	90.9%

Respondents reported awareness and knowledge of home quarantine instructions found most of the subjects agreed that family members living with quarantined patients should check their temperature daily (97.5%) and the quarantined subject should wear masks at home all the time (96.1%). However, only half of the subjects (51.3%) were able to answer that the ideal number of care providers for the person who is ill with COVID-19 should be only one. About 70% and 26%

1  
2  
3 answered the ideal ratio of bleach solution for cleaning were 1:99 and 1:49 respectively. As to the  
4 ideal distance with the quarantine subject in the same room, 324 (42.4%) and 264 (34.6%) subjects  
5 answered 2 meters and 1 meter respectively.  
6

## 7 **DISCUSSION**

8  
9  
10 During large-scale public health emergencies, home care may be the only viable method of  
11 providing continuous health care due to disruption of services and transportation. In many regions  
12 around the world, health care systems have been overwhelmed by high caseloads of COVID-19  
13 patients with life-threatening conditions, necessitating greater reliance on informal home care  
14 providers. Home care during COVID-19 includes not only people caring for those with confirmed  
15 or suspected COVID-19; but also care for non-COVID-related conditions that may require  
16 essential life sustaining care, health maintaining support, or/and additional care during this period.  
17 This is the first study to examine informal home care provision in high-income, urban context  
18 during a large-scale public health emergency. In our general population study sample of Hong  
19 Kong adults, approximately one-fourth reported to have provided informal home care during  
20 COVID-19 epidemic. Consistent with previous literature<sup>8</sup>, females shouldered the main burden of  
21 being a primary home care provider. The COVID-19 pandemic presents a complex set of  
22 additional burdens on these home care providers. More than half of the informal home care  
23 providers reported additional mental strain during the epidemic.  
24  
25  
26

27 Although the majority of informal home care providers believed that they had sufficient knowledge  
28 for their normal home care duties, we noted that some subgroups felt themselves to be  
29 insufficiently knowledgeable to provide even routine care. Previous studies have shown that older  
30 age and less educated care providers reported a higher mental burden from caregiving<sup>24,25</sup>.  
31 Consistent with this, we noted home care providers who were older, housewives, and with lower  
32 education and income were more likely to believe themselves as lacking knowledge to provide  
33 routine care. Moreover, those caring for dependent individuals (e.g. fragile elderly and disabled)  
34 felt inadequately knowledgeable, possibly due to heavy reliance on existing services for regular  
35 management of fragile elderly and people with disabilities by the government<sup>26</sup>. In contrast to the  
36 provision of routine informal home care, nearly half of the informal home care providers reported  
37 that they had insufficient knowledge to mitigate the additional health risks from the COVID-19  
38 epidemic and these findings were not associated with education or other factors.  
39  
40  
41

42 On top of the additional economic and knowledge burden brought on by the worldwide pandemic,  
43 approximately half of the care providers reported additional mental strain during the epidemic.  
44 The most common reasons cited were the concerns of risk of COVID-19 infection in family, the  
45 longer duration of providing care and the additional caregiving tasks brought about from the  
46 pandemic. Nearly 40% of informal care provider reported that their caregiving duties had also  
47 caused increased difficulty in their daily life. Those reporting higher mental burden were often  
48 caring for dependent family members, and necessitating taking personal leave for the caregiving  
49 duties. Due to the COVID-19 pandemic, many community services like social community center<sup>27</sup>,  
50 day care center<sup>12</sup> and schools<sup>28</sup> were closed in Hong Kong. Hence, these home care providers with  
51 dependent care recipients require additional support services during public health emergencies.  
52 Furthermore, more than half of the care recipients were children and teenagers, who added to the  
53 caregiving burden during the nearly four-month, territory-wide school closures. The closure of  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 schools and elderly services has curtailed health access during the epidemic with 40% of the care  
4 providers reporting to have ceased or reduced using those services. In addition, it was found that  
5 the caregiving burden was highest in the economically-active age group (aged 18 to 44). These  
6 individuals were often faced with a double burden of working and providing informal home care.  
7 Although government had subsidized the wages to employees<sup>29</sup>, further support should target this  
8 care provider group. For example, providing sufficient information and services in internet or  
9 smartphone app, as younger aged care provider was found to be using more internet and  
10 smartphone app as their main information source comparing to other aged group<sup>16</sup>.  
11  
12

13  
14 There were a few limitations in this study. First, the study recruitment relied on land-based  
15 telephone. Households without land-based telephone services would be missed. However, the  
16 penetration rate of the residential fixed line services in Hong Kong was 85.5% in December 2019<sup>30</sup>.  
17 In addition, our study population was comparable with the latest population Census in Hong Kong,  
18 which was generalizable to the general population. Furthermore, the study was conducted during  
19 the peak period of COVID-19 epidemic in Hong Kong. Citizens were encouraged to stay at home  
20 for work or daily activity. Hence, the respondents would be more compliant and attentive to the  
21 telephone survey<sup>31</sup>. Secondly, the cross-sectional study design can only demonstrate associations  
22 between patterns and social-demographic predictors, as causation cannot be attributed to the  
23 findings. Thirdly, this study might subject to reporting bias since data were self-reported, and data  
24 from non-respondents could not be obtained. Lastly, for the sample size of the subjects who  
25 perceived lacking knowledge to provide routine care was small (n=20). Hence, advanced statistical  
26 analysis was not possible. Qualitative interviews might have revealed more rich and detailed  
27 insights.  
28  
29

30  
31 Although the SARS-CoV-2/COVID-19 pandemic has engendered a huge amount of clinical,  
32 epidemiological and vaccine-related research, the socio-economic impact of COVID-19 has not  
33 yet been well-examined. Home care, being one of the crucial pillars in supporting people's health  
34 outside the formal healthcare setting during this pandemic, needs much stronger research and  
35 support from stakeholders at various levels<sup>32</sup>. In addition to research in formal healthcare services,  
36 better understanding of the challenges posed by the various home care settings (even informal  
37 settlements) is urgently required. This includes disease management in home care settings and  
38 strategies to optimize resources and support for informal care providers during global pandemics  
39 such as COVID-19. This study examined informal home care providers in a high-income Asian  
40 city during the early phase of the pandemic. However, the long-term implications on care  
41 providers, health outcomes of care recipients, and coping strategies of vulnerable people  
42 (particularly those living alone) are largely unknown. Research in these areas is urgently needed  
43 to improve pandemic preparedness of national health systems.  
44  
45  
46  
47

## 48 CONCLUSION

49

50  
51 This study explores home care situation in Hong Kong, an Asia metropolis in China which  
52 experienced the early phase of COVID-19 in 2020. Findings showed home care during pandemic  
53 can present a complex set of care recipient needs and providers' duties in densely-high-rise  
54 building based aging community with a high dependency ratio. The study also showed that  
55 younger workers with higher education and income had to bear the main burden of care for  
56  
57

1  
2  
3 dependent care recipients during the epidemic but the heaviest routine care burden fell upon those  
4 with deficit resource. Governments should consider supplementing service support during large-  
5 scale public health emergencies when access to routine health care is disrupted. Policy should  
6 focus on continuous support to those informal care providers and their mental health needs during  
7 these public health emergencies.  
8  
9

## 10 **Figures**

11  
12 Figure 1a. Characteristics of care provider-recipient relationship among all care recipients, as  
13 reported by informal care providers (N=345)  
14

15 Figure 1b. Age distribution of dependent care receiver (who cannot live normally without  
16 caregivers' help)  
17

18 Figure 2. The relationship between household income and informal home care duties  
19

## 20 **Funding**

21 This work was supported by CCOUC-Oxford research support fund (#0008).  
22  
23  
24  
25

## 26 **Competing interests**

27  
28 All authors have completed the ICMJE uniform disclosure form at  
29 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) and declare: no support from any organization for the  
30 submitted work; no financial relationships with any organizations that might have an interest in  
31 the submitted work in the previous three years; no other relationships or activities that could appear  
32 to have influenced the submitted work.  
33  
34  
35

## 36 **Contributors**

37  
38 EYYC, KKCH, ELYW, SYSW, & NG conceived the project. EYYC, ESKL, KKCH, ZH designed  
39 the study tool, obtained, validated, and cleaned the data. ESKL, ZH and JHK performed the data  
40 analysis. EYYC, ELYW, ESKL, JHK, HH and ZH involved in literature review and write up. All  
41 authors contributed to the manuscript drafting, review, revision and approval of the final  
42 manuscript. KKCH, ESKL, HH SYSW and ZH provided administrative and operational support.  
43 The corresponding author attests that all listed authors meet authorship criteria and that no others  
44 meeting the criteria have been omitted.  
45  
46  
47  
48

## 49 **Ethical Approval**

50  
51 Verbal consent was obtained from the participant and ethics approval and consent procedure of  
52 the study was reviewed and obtained from the Survey and Behavioral Research Ethics  
53 Committee at The Chinese University of Hong Kong (SBRE-19-498).  
54  
55  
56  
57  
58  
59  
60

### Data sharing statement

No additional data are available.

**Word count: 3903**

### Licence

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd (“BMJ”) its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in BMJ Open and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge (“APC”) for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.



## Reference

1. World Health Organization. Home care for patients with COVID-19 presenting with mild symptoms and management of contacts. Who. 2020.
2. World Health Organization. Home-based and long-term care: Home care issues and evidence [Internet]. Geneva; 1999. Available from: [https://apps.who.int/iris/bitstream/handle/10665/66096/WHO\\_HSC\\_LTH\\_99.2.pdf?sequence=1&isAllowed=y](https://apps.who.int/iris/bitstream/handle/10665/66096/WHO_HSC_LTH_99.2.pdf?sequence=1&isAllowed=y)
3. Li J, Song Y. Formal and Informal Care. In: Gu D, Dupre ME, editors. Encyclopedia of Gerontology and Population Aging [Internet]. Cham: Springer International Publishing; 2019. p. 1–8. Available from: [https://doi.org/10.1007/978-3-319-69892-2\\_847-1](https://doi.org/10.1007/978-3-319-69892-2_847-1)
4. Dow J, Robinson J, Robalino S, Finch T, McColl E, Robinson L. How best to assess quality of life in informal carers of people with dementia; A systematic review of existing outcome measures. PLoS ONE. 2018.
5. Amer Nordin A, Mohd Hairi F, Choo WY, Hairi NN. Care Recipient Multimorbidity and Health Impacts on Informal Caregivers: A Systematic Review. Gerontologist. 2019;
6. Johnson S, Bacsu J, Abeykoon H, McIntosh T, Jeffery B, Novik N. No Place Like Home: A Systematic Review of Home Care for Older Adults in Canada. Can J Aging. 2018;
7. Lou WV. Financial Impacts of Family Caregiving: an Investigation of the Moderating Effects of Workplace Accommodative Measures and Domestic Helpers [Internet]. 2017. Available from: [https://www.pico.gov.hk/doc/en/research\\_report\(PDF\)/2015\\_A8\\_031\\_16A\\_Final\\_Report\\_Dr\\_Lou.pdf](https://www.pico.gov.hk/doc/en/research_report(PDF)/2015_A8_031_16A_Final_Report_Dr_Lou.pdf)
8. Ho SC, ACM C, JTF L, J W. A study of informal caregivers and the association of caregiving status with health and quality of life. Hong Kong Med J [Internet]. 2007;13(Supp 5):S4-7. Available from: <https://www.hkmj.org/system/files/hkm0710sp5p4.pdf>
9. Stein RA. COVID-19 and rationally layered social distancing. International Journal of Clinical Practice. 2020.
10. Wilder-Smith A, Chiew CJ, Lee VJ. Can we contain the COVID-19 outbreak with the same measures as for SARS? The Lancet Infectious Diseases. 2020.
11. Education Bureau of the government of Hong Kong Special Administration. Deferral of Class Resumption for All Schools Together, We Fight the Virus [Internet]. 2020 [cited 2020 May 5]. Available from: [https://www.edb.gov.hk/attachment/en/sch-admin/admin/about-sch/diseases-prevention/edb\\_20200331\\_eng.pdf](https://www.edb.gov.hk/attachment/en/sch-admin/admin/about-sch/diseases-prevention/edb_20200331_eng.pdf)
12. Government of the Hong Kong Special Administrative Region. LNY welfare services set [Internet]. news.gov.hk. 2020 [cited 2020 Apr 24]. Available from: [https://www.news.gov.hk/eng/2020/01/20200127/20200127\\_233955\\_845.html](https://www.news.gov.hk/eng/2020/01/20200127/20200127_233955_845.html)
13. New.gov.hk. Quarantine measures enhanced [Internet]. 2020 [cited 2020 May 7]. Available from: [https://www.news.gov.hk/eng/2020/03/20200317/20200317\\_202509\\_713.html](https://www.news.gov.hk/eng/2020/03/20200317/20200317_202509_713.html)
14. Centre for Health Protection of the Government of Hong Kong Special Administrative Region. List of buildings of the confinees under mandatory quarantine according to Cap. 599C of Hong Kong Laws [Internet]. 2020 [cited 2020 May 7]. Available from: [https://www.chp.gov.hk/files/pdf/599c\\_tc.pdf](https://www.chp.gov.hk/files/pdf/599c_tc.pdf)
15. Census and Statistics Department of Government of Hong Kong Special Administrative Region. Domestic Households in Hong Kong [Internet]. 2016 [cited 2020 Apr 24]. Available from: <https://www.byccensus2016.gov.hk/en/Snapshot-04.html>

16. Chan EYY, Huang Z, Lo ESK, Hung KKC, Wong ELY, Wong SYS. Sociodemographic predictors of health risk perception, attitude and behavior practices associated with Health-Emergency Disaster Risk Management for biological hazards: the case of COVID-19 pandemic in Hong Kong, SAR China. *Int J Environ Res Public Health*. Forthcoming.
17. Chan EY-Y, Cheng CK-Y, Tam GC-H, Huang Z, Lee PY. Willingness of future A/H7N9 influenza vaccine uptake: A cross-sectional study of Hong Kong community. *Vaccine* [Internet]. 2015 Sep 11;33(38):4737–40. Available from: <http://www.sciencedirect.com/science/article/pii/S0264410X15010063>
18. Chan EYY, Cheng CKY, Tam G, Huang Z, Lee P. Knowledge, attitudes, and practices of Hong Kong population towards human A/H7N9 influenza pandemic preparedness, China, 2014. *BMC Public Health* [Internet]. 2015;15:943. Available from: <http://www.biomedcentral.com/1471-2458/15/943>
19. Tam G, Huang Z, Chan EYY. Household preparedness and preferred communication channels in public health emergencies: A cross-sectional survey of residents in an asian developed Urban city. *Int J Environ Res Public Health*. 2018;15(8).
20. Chan, Ying Yang Emily, Wong CS. Public health prevention hierarchy in disaster context. In: Chan, Ying Yang Emily, Shaw R, editors. *Public health and disasters - Health Emergency and Disaster Risk Management in Asia*. Tokyo: Springer; 2020. p. 7–17.
21. Centre for Health Protection of the government of Hong Kong Special Administrative Region. *Communicable Diseases* [Internet]. 2020 [cited 2020 May 7]. Available from: <https://www.chp.gov.hk/en/resources/464/102466.html>
22. Census and Statistics Department of the Government of the Hong Kong Special Administrative Region. *Main Table (By-Census Results)* [Internet]. [cited 2019 Oct 31]. Available from: <https://www.bycensus2016.gov.hk/en/bc-mt.html>
23. IBM. *SPSS Statistics 21.0 Available for Download* [Internet]. 2020 [cited 2020 May 27]. Available from: <https://www.ibm.com/support/pages/spss-statistics-210-available-download>
24. Chow EO wah, Ho HCY. Caregiver strain, age, and psychological well-being of older spousal caregivers in Hong Kong. *J Soc Work*. 2015;
25. Oedekoven M, Amin-Kotb K, Gellert P, Balke K, Kuhlmeiy A, Schnitzer S. Associations between Informal Caregivers' Burden and Educational Level. *GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry*. 2019.
26. Social Welfare Department. *Integrated Home Care Services* [Internet]. 2015 [cited 2020 Apr 24]. Available from: [https://www.swd.gov.hk/doc/elderly/IHCS\(Nov2015\).pdf](https://www.swd.gov.hk/doc/elderly/IHCS(Nov2015).pdf)
27. Government of the Hong Kong Special Administrative Region. *Public service arrangements updated* [Internet]. *news.gov.hk*. 2020 [cited 2020 Apr 24]. Available from: [https://www.news.gov.hk/eng/2020/03/20200322/20200322\\_131634\\_065.html?type=ticker](https://www.news.gov.hk/eng/2020/03/20200322/20200322_131634_065.html?type=ticker)
28. Government of the Hong Kong Special Administrative Region. *No delay in fight against virus: CE* [Internet]. *news.gov.hk*. 2020 [cited 2020 Apr 24]. Available from: [https://www.news.gov.hk/chi/2020/01/20200125/20200125\\_191553\\_178.html?type=category&name=covid19&tl=t](https://www.news.gov.hk/chi/2020/01/20200125/20200125_191553_178.html?type=category&name=covid19&tl=t)
29. *News.gov.hk*. *Gov't unveils employment measures*. 2020 Apr 20 [cited 2020 May 19]; Available from: [https://www.news.gov.hk/eng/2020/04/20200420/20200420\\_175816\\_569.html](https://www.news.gov.hk/eng/2020/04/20200420/20200420_175816_569.html)
30. Office of the Communications Authority *Key Communications Statistics of the government*

- 1  
2  
3 of Hong Kong Special Administrative Region. Key Communications Statistics [Internet].  
4 2019 [cited 2020 May 28]. Available from:  
5 [https://www.ofca.gov.hk/en/data\\_statistics/data\\_statistics/key\\_stat/](https://www.ofca.gov.hk/en/data_statistics/data_statistics/key_stat/)  
6  
7 31. Office of the Communications Authority. Key Communications Statistics [Internet]. 2012  
8 [cited 2020 Apr 24]. Available from:  
9 [https://www.ofca.gov.hk/en/data\\_statistics/data\\_statistics/key\\_stat/](https://www.ofca.gov.hk/en/data_statistics/data_statistics/key_stat/)  
10  
11 32. Chan EY, Gobat N, Hung H, MacGregor H, Wong E. Health-Emergency and Disaster  
12 Management (Health-EDRM) Technical Brief Series: A review on implications of home  
13 care on biological hazard. 2020.  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For peer review only

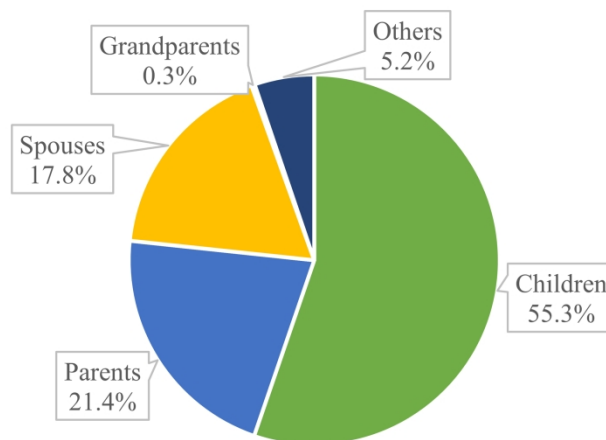


Figure 1a. Characteristics of care provider-recipient relationship among all care recipients, as reported by informal care providers (N=345)

135x101mm (600 x 600 DPI)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

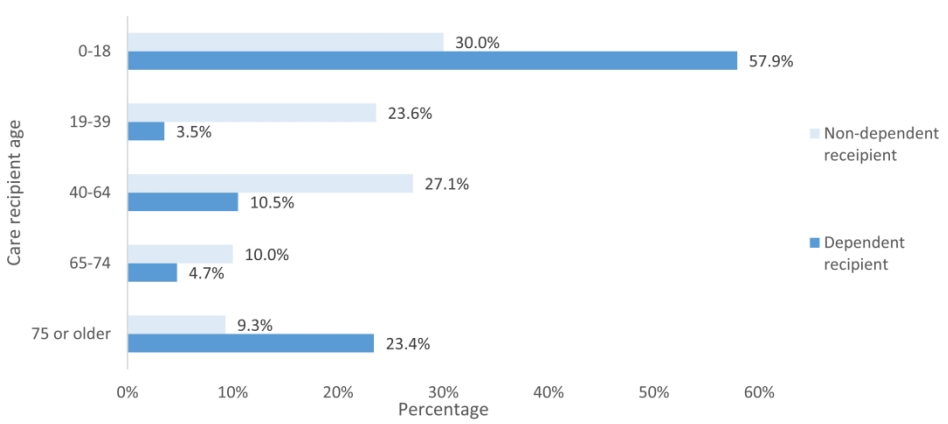


Figure 1b. Age distribution of dependent care receiver (who cannot live normally without caregivers' help)

177x88mm (600 x 600 DPI)

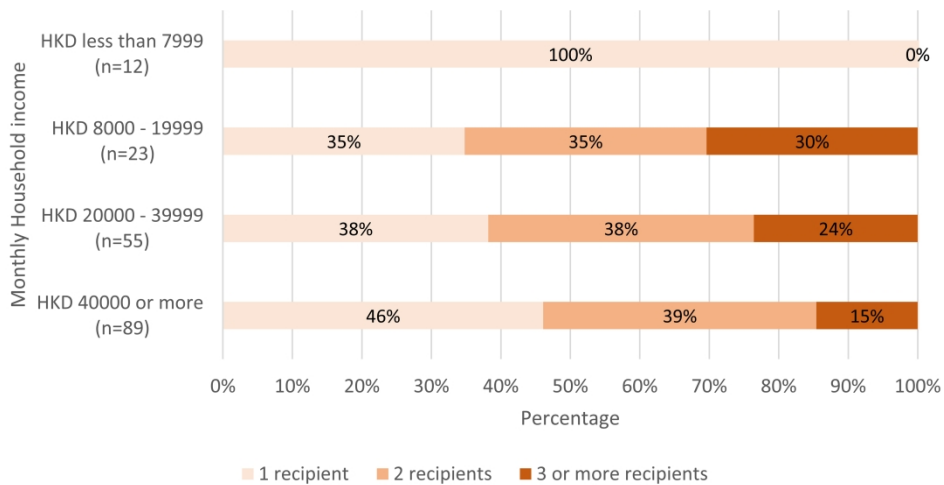


Figure 2. The relationship between household income and informal home care duties

177x88mm (600 x 600 DPI)

# Table of contents

Page

Table S1. Factors associated with self-perceived increased difficulty in daily living .....2

Table S2. Sociodemographic predictors for care providers who believed to have adequate knowledge for routine care and COVID infection control.....5

For peer review only

Table S1. Factors associated with self-perceived increased difficulty in daily living

	No	Yes	p	AOR (LB-UB)	p
N	120	71			
<b>Socio-demographic</b>					
Age <sup>a</sup>			0.306		
18-44	34.2%	43.7%			
45-64	49.2%	38.0%			
65 or more	16.7%	18.3%			
Gender			0.441		
Male	35.0%	29.6%			
Female	65.0%	70.4%			
Education attainment			0.356		
Primary level or below	10.0%	4.2%			
Secondary level	48.3%	52.1%			
Tertiary level	41.7%	43.7%			
Occupation			0.903		
White collar	44.8%	44.3%			
Blue collar (including services and sales)	19.0%	17.1%			
Housewives	21.6%	25.7%			
Students	0.9%	0.0%			
Unemployed or retired	13.8%	12.9%			
Housing			0.703		
Public housing	25.8%	21.1%			
Subsidized housing	13.3%	9.9%			
Private housing (including independent villa)	60.0%	67.6%			
Others	0.8%	1.4%			
Household income			0.422		
<7999	4.5%	10.6%			
8000 – 19999	14.3%	10.6%			
20000 – 39999	30.4%	30.3%			
40000 or more	50.9%	48.5%			
Housing size			0.397		
Small (350ft or below)	16.2%	22.4%			
Medium (351 ft- 800ft)	67.6%	67.2%			
Large (801 ft. or above)	16.2%	10.4%			
Chronic disease condition			0.616		
No	79.2%	76.1%			
Yes	20.8%	23.9%			
Marital status			0.001		
Unmarried (including divorced or widow)	32.5%	11.3%		Ref.	
Married	67.5%	88.7%		2.81 (0.98 – 8.09)	0.055



Having sufficient knowledge to take care their family members			0.463		
Not sure or No	9.6%	13.0%			
Yes	90.4%	87.0%			
<b>Characteristics of the care recipient</b>					
Number of care recipient			0.797		
1 recipient	47.5%	43.7%			
2 recipients	35.0%	35.2%			
3 or more recipients	17.5%	21.1%			
Family member as fragile elderly or disabilities			0.958		
No	68.6%	69.0%			
Yes (with either one)	31.4%	31.0%			
Children were the care recipients			0.075		
No	42.5%	29.6%		Ref.	
Yes	57.5%	70.4%		0.83 (0.34 – 2.05)	0.688
Spouse was the care recipient			0.148		
No	73.3%	63.4%			
Yes	26.7%	36.6%			
Parents or parents-in-law were the care recipients*			0.033		
No	65.8%	80.3%		Ref.	
Yes	34.2%	19.7%		0.23 (0.08- 0.70)	0.009
Family member who were dependent recipients *			<0.001		
No	49.1%	13.0%		Ref.	
Yes	50.9%	87.0%		6.38 (2.69 – 15.14)	<0.001
Family member received care due to staying at home during COVID-19 outbreak ^			0.053		
No	81.9%	69.6%		Ref.	
Yes	18.1%	30.4%		1.70 (0.70 – 4.13)	0.238
Family member who receive care mainly due to their chronic condition			0.709		
No	88.8%	87.0%			
Yes	11.2%	13.0%			
<b>The effect brought by COVID-19</b>					
Stopped or decrease the use of community services during COVID-19 outbreak+			0.007		
No	95.8%	84.5%		Ref.	

	Yes	4.2%	15.5%		3.22 (0.73 – 14.19)	0.122
	Need to take personal leave for caregiving responsibility*			<0.001		
	No	92.4%	63.4%		Ref.	
	Yes	7.6%	36.6%		7.15 (2.44 – 20.91)	<0.001

+Using Fisher's exact test,  $\hat{p}<0.10$ , \*  $p<0.05$ ,

<sup>a</sup>The age group "18-24" and "25-44" were collapsed

In the multivariable logistic regression, there were 7 missing values in variable *family member who were dependent recipients*, 2 missing values in *stopped or decrease the use of community services during COVID-19 outbreak*, 2 missing values in *need to take personal leave for caregiving responsibility*, 7 missing values in *stay at home during COVID-19 outbreak*, and 1 missing value in *perceived increased difficulty in daily live*

For peer review only

Table S2. Sociodemographic predictors for care providers who believed to have adequate knowledge for routine care and COVID infection control

N	Knowledge for routine care			Knowledge of COVID-19 risk mitigation		
	20 (10.9%)	164 (89.1%)	p	95 (49.5%)	97 (50.5%)	p
	Not enough knowledge	Enough knowledge		Not enough knowledge	Enough knowledge	
<b>Socio-demographic details</b>						
Age <sup>ab</sup>			0.036*			0.349
18-44	25.0%	39.6%		43.2%	33.0%	
45-64	35.0%	45.1%		41.1%	48.5%	
65 or more	40.0%	15.2%		15.8%	18.6%	
Gender			0.455			0.958
Male	40.0%	31.7%		32.6%	33.0%	
Female	60.0%	68.3%		67.4%	67.0%	
Education attainment			<0.001*			0.160
Primary or below	30.0%	4.3%		10.5%	5.2%	
Secondary	45.0%	49.4%		52.6%	46.4%	
Tertiary	25.0%	46.3%		36.8%	48.5%	
Marital status <sup>a</sup>			0.786			0.453
Non-married	20.0%	25.0%		27.4%	22.7%	
Married	80.0%	75.0%		72.6%	77.3%	
Housing <sup>a</sup>			0.236			0.897
Public housing	40.0%	22.0%		23.2%	25.8%	
Subsidized housing	15.0%	12.2%		13.7%	10.3%	
Private housing (including independent villa)	45.0%	65.2%		62.1%	62.9%	
Others	0.0%	0.6%		1.1%	1.0%	
Living density (household size / number of people) <sup>a</sup>			0.900			0.428
<200 ft per ppl	62.5%	60.9%		65.5%	59.8%	
200 ft or more per ppl	37.5%	39.1%		34.5%	40.2%	
Main information channel <sup>a</sup>			0.653			0.249
Television	50.0%	34.1%		38.9%	34.0%	
Internet or smartphone app	45.0%	57.9%		56.8%	55.7%	

Others (newspaper, radio)	5.0%	7.9%		4.2%	10.3%	
Housing size <sup>a</sup>			0.104			0.547
Small (350ft or below)	31.3%	16.7%		20.7%	16.3%	
Medium (351 ft-800ft)	68.8%	67.3%		67.8%	67.4%	
Large (801 ft. or above)	0.0%	16.0%		11.5%	16.3%	
Family income group <sup>a</sup>			<0.001*			0.323
<7999	27.8%	4.5%		5.8%	7.5%	
8000 – 19999	11.1%	13.5%		12.8%	12.9%	
20000 – 39999	50.0%	27.6%		37.2%	24.7%	
40000 or more	11.1%	54.5%		44.2%	54.8%	
Employment <sup>a</sup>			0.010*			0.699
White collar	15.0%	49.1%		44.6%	44.2%	
Blue collar (including services and sales)	20.0%	17.6%		18.5%	18.9%	
Students	0.0%	0.0%		25.0%	21.1%	
Housewives	45.0%	20.1%		1.1%	0.0%	
Unemployment and retired	20.0%	13.2%		10.9%	15.8%	
<b>Care recipient characteristics</b>						
Children were the care recipients			0.059			0.528
No	55.0%	33.5%		35.8%	40.2%	
Yes	45.0%	66.5%		64.2%	59.8%	
Spouse was the care recipient			0.723			0.594
No	65.0%	68.9%		71.6%	68.0%	
Yes	35.0%	31.1%		28.4%	32.0%	
Parents or parents-in-law were the care recipients			0.597			0.480
No	65.0%	70.7%		73.7%	69.1%	
Yes	35.0%	29.3%		26.3%	30.9%	
Family members were dependent recipients			0.044*			0.817
No	15.0%	37.8%		34.8%	36.5%	

	Yes	85.0%	62.2%		65.2%	63.5%	
Members were fragile elderly or disabilities				0.040*			0.709
	No	47.4%	70.6%		70.2%	67.7%	
	Yes	52.6%	29.4%		29.8%	32.3%	
<sup>a</sup> Fisher's exact test was performed for analysis about "knowledge for routine care" <sup>b</sup> The age group "18-24" and "25-44" were combined as the age group "18-24" only have 2 subjects * $p < 0.05$							

For peer review only

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5
		(b) Describe any methods used to examine subgroups and interactions	5
		(c) Explain how missing data were addressed	5
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	5
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5,7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5,7
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	6-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-11

		(b) Report category boundaries when continuous variables were categorized	6-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-13
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Characteristics and well-being of urban informal home care providers during COVID-19 pandemic: a population-based study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-041191.R1
Article Type:	Original research
Date Submitted by the Author:	31-Aug-2020
Complete List of Authors:	<p>Chan, Emily; The Chinese University of Hong Kong, JC School of Public Health and Primary Care; University of Oxford, Nuffield Department of Medicine</p> <p>Lo, Eugene; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Huang, Zhe; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Kim, Jean ; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Hung, Heidi; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Hung, Kevin KC; Chinese University of Hong Kong, Accident and Emergency Medicine Academic Unit</p> <p>Wong, Eliza LY; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Wong, Samuel; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Gobat, Nina; University of Oxford, Nuffield Department of Medicine</p>
<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	General practice / Family practice
Keywords:	Public health < INFECTIOUS DISEASES, PRIMARY CARE, PUBLIC HEALTH

SCHOLARONE™  
Manuscripts





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

# Characteristics and well-being of urban informal home care providers during COVID-19 pandemic: a population-based study

Emily Ying Yang Chan<sup>1,2,3\*</sup>, Eugene Siu Kai Lo<sup>1,3</sup>, Zhe Huang<sup>1,3</sup>, Jean H Kim<sup>3</sup>, Heidi Hung<sup>1,3</sup>, Kevin Kei Ching Hung<sup>1,4</sup>, Eliza Lai Yi Wong<sup>3</sup>, Samuel Yeung Shan Wong<sup>3</sup>, Nina Gobat<sup>5</sup>

<sup>1</sup> Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), The Chinese University of Hong Kong, Hong Kong, China; emily.chan@cuhk.edu.hk; euglks@cuhk.edu.hk; huangzhe@cuhk.edu.hk

<sup>2</sup> Nuffield Department of Medicine, University of Oxford, Oxford OX37BN, UK

<sup>3</sup> JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, China;

<sup>4</sup> Accident & Emergency Medicine Academic Unit, The Chinese University of Hong Kong, Prince of Wales Hospital, Hong Kong SAR, China; kevin.hung@cuhk.edu.hk

<sup>5</sup> Primary Health Care, Nuffield Department of Medicine, University of Oxford. nina.gobat@phc.ac.ox.uk

\* Correspondence: emily.chan@cuhk.edu.hk; Tel.: +852-2252-8702

## ABSTRACT

### Objectives

Globally, the COVID-19 pandemic has overwhelmed many health care systems and individuals are unable to access routine clinical care during lockdowns. Informal home care, care provided by non-healthcare professionals, increases the community's health care capacity during pandemics. There is, however, limited research about the characteristics of informal home care providers and the challenges they face during such public health emergencies.

### Design

A random, cross-sectional, population-based telephone survey study was conducted to examine patterns of home care, characteristics of informal home care providers and the challenges of these care providers during this pandemic.

### Setting

Data were collected from 22 March to 1 April 2020 in Hong Kong, China.

### Participants

A population representative study sample of Chinese-speaking adults (n=765) was interviewed.

### Primary and secondary outcome measures

The study examined the characteristics of informal home care providers, and the characteristics and health care requirements of the care recipients. The study also examined providers' self-perceived knowledge to provide routine home care as well as COVID-19 risk reduction care. Respondents were asked about mental health related to COVID-19.

### Results

Of the respondents, 25.1% of 765 provided informal home care during the studied COVID-19 pandemic period. Of informal home care providers, 18.4% of respondents took leave from school/work during the epidemic to provide care that included fragile elderly and small children.

1  
2  
3 48 These care providers tended to be younger-aged, female, and housewives. Approximately half of  
4 49 care providers reported additional mental strain and 37.2 % reported of challenges in daily living  
5 50 during epidemic. Although most informal home care providers felt competent to provide routine  
6 51 care, 49.5% felt inadequately prepared to cope with the additional health risks of COVID-19.  
7 52

### 8 53 Conclusion

9 54 During public health emergencies, heavy reliance on informal home health care providers  
10 55 necessitates better understanding of their specific needs and increased government services to  
11 56 support informal home care.  
12 57

13 58 **Keywords:** Informal home care, health and well-being, COVID 19, Urban, Asia, Hong Kong  
14 59

15 60 **Abstract word count: 300**  
16 61  
17 62

### 63 **Strengths and limitation of this study**

64 In a city affected in the early stages of the COVID-19 pandemic, this study was the first to  
65 highlight the impact and added burden of care experienced by informal home care providers  
66 among the general population.

67 This telephone-based study was conducted during the peak period of COVID-19 epidemic in  
68 Hong Kong, so the citizen would be more compliant and attentive to the telephone survey as they  
69 were encouraged to stay at home for work or daily activity.

70 The cross-sectional design cannot draw a conclusion on any cause-effect relationship.

71 this study might subject to reporting bias since data were self-reported, and data from non-  
72 respondents could not be obtained.

73

### 74 **INTRODUCTION**

75

76 Home care is regarded as one of the major care models to address medical needs for patients and  
77 vulnerable populations during COVID-19 pandemic<sup>1</sup>. As described by the World Health  
78 Organization (WHO)<sup>2</sup>, home care aims to provide high quality and cost-effective care to  
79 individuals that will enable them to maintain their independence and the highest possible quality  
80 of life. While formal home care providers are usually remunerated workers from medical  
81 authorities or registered organizations, informal home care providers are usually family members  
82 or others who provide unpaid care to those in need<sup>3</sup>. The typical profile of individuals who require  
83 home care are patients with chronic diseases or mental conditions, individuals with disabilities,  
84 young children, the elderly and other vulnerable individuals who live alone. Up to the present, the  
85 published literature has mainly examined the quality of life of older adults, the care recipients, the  
86 mental health of the care providers<sup>4-6</sup> and experience of informal home care providers under non-  
87 emergency health situations<sup>7,8</sup>.

88

89 During the COVID-19 pandemic, in an attempt to reduce the surge of patients requiring hospital  
90 care, many countries have implemented epidemic control measures<sup>9</sup> to limit activities outside the  
91 home such as closure of non-essential services. Moreover, countries have relied heavily on home  
92 quarantine for suspected COVID-19 patients with mild-symptoms in order to maintain resilience  
93 of the national health system<sup>1,9,10</sup>. In Hong Kong, in conjunction with prohibitions on mass  
94 gatherings, closure of recreational centers, schools and community services<sup>11,12</sup>, a mandatory 14-  
95 days quarantine was issued for those who entered into Hong Kong from outside its borders<sup>13</sup>. This  
96 resulted in 13,649 individuals under compulsory home quarantine from 13 Mar to 26 Mar 2020<sup>14</sup>.  
97 In such a public health emergency, informal care may be the only care option for people in need<sup>15</sup>.  
98 There have been no published studies of informal care providers during extreme events or during  
99 population-level health emergencies. Hence, the impacts on informal home care providers from  
100 the closure of community services and limited access to healthcare services during the COVID-19  
101 are yet unknown.

102

1  
2  
3 103 According to the Hong Kong 2016 By-census, one-fourth of households had children aged under  
4 104 15 while and one-third household reported having at least one elderly household member<sup>16</sup>.  
5 105 Combined, these households were particularly in need of home care even in ordinary setting,  
6 106 accounting for 27.2% of the whole Hong Kong population. The likely heavy reliance on informal  
7 107 home care during a pandemic emergency in Hong Kong allows examination of the prevalence and  
8 108 special needs of informal home care providers. This study aimed to identify the pattern of informal  
9 109 home care , characteristics of informal home care providers and their challenges in Hong Kong  
10 110 during the COVID-19 epidemic. The study also seeks to examine the knowledge levels and level  
11 111 of preparation for the home quarantine among these care providers and the recipients of their care  
12 112 in Hong Kong.  
13 113

## 14 114 **METHODS**

### 15 115

### 16 116 **Study design and study population**

17 117  
18 118 A cross-sectional, population-based telephone survey was conducted from 22 March to 1 April  
19 119 2020 during the peak of local COVID-19 pandemic. The computerized Random Digit Dialing  
20 120 (RDD) method was used for each of Hong Kong's 18 districts to randomly select a representative  
21 121 sample. The survey methods and the sample size estimation have been previously detailed<sup>17</sup>. It  
22 122 was designed on the basis of literature review and previous research experience<sup>18-21</sup>. The study  
23 123 only includes respondents who were 18 years old or older, and speak Cantonese.  
24 124

### 25 125 **The study instruments**

26 126  
27 127 A self-reported, semi-structured Chinese questionnaire was used for data collection<sup>17</sup>. The data  
28 128 collected includes the subjects' perception, knowledge preparedness, their home care experience  
29 129 if available toward and during the COVID-19 pandemic. Since the home care recipients could  
30 130 include a wide range of different groups (e.g. healthy children due to the closure of schools), care  
31 131 providers were identified through one of the questions in the questionnaire "Do you currently need  
32 132 to look after member(s) of your family and relatives' daily needs (like your children/parents)  
33 133 during COVID-19 epidemic?". Besides the experience and situations of their care duties during  
34 134 the COVID-19, the characteristics of the care recipients under their care were also investigated.  
35 135 Care recipients' age, sex, relationship with the care provider, the reason for the receiving care and  
36 136 their dependency were recorded. Care providers were also asked if they were the primary care  
37 137 providers for their recipients (defined as having the major responsibility in caregiving duties) and  
38 138 if their care recipient was dependent on them (defined as inability to maintain activities of daily  
39 139 living without care provider assistance). All self-reported home care providers in this study were  
40 140 confirmed to be informal care provider.  
41 141

42 142 Care providers were asked if they felt that they possessed sufficient knowledge about routine care  
43 143 and COVID-19 risk mitigation. A 5-point Likert scale was used to assess physical, mental, social  
44 144 and other related health impact (ranging from 1= no impact to 5= maximum impact). Respondents  
45 145 were asked about their home care experience, risks perception, household capacity to provide care  
46 146 and home care challenges that they experienced. The instrument also asked about knowledge of  
47 147 infection control during a home quarantine. Specifically, the respondents were asked about their  
48 148 knowledge of infection control in home context such as *the ratio of bleach solution for cleaning*  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 149 (*1.99 ratio for normal cleaning and 1.49 for cleaning vomit, excreta or secretion*<sup>22</sup>), the  
4 150 *recommended distance for with the quarantine subjects (at least 1 meter*<sup>22</sup>).  
5 151

### 152 **Statistical analysis**

8 153 Descriptive statistics of the study sample were presented with chi-square tests to examine  
9 154 comparability of the study sample with the Hong Kong general census population<sup>23</sup>. Socio-  
10 155 demographic pattern analyses of respondents who might have care-providing responsibilities, the  
11 156 home care recipients, and the context of care provision during the COVID-19, were conducted.  
12 157 Chi-square test was conducted for comparing the perception toward COVID-19 between care  
13 158 provider and non-care provider subjects. Multivariable logistic regression analysis was conducted  
14 159 to compare the sociodemographic predictors between care providers and non-care providers. In  
15 160 addition, logistic regression analysis was conducted to understand how the socio-demographic of  
16 161 the care provider and their care responsibilities may affect their daily living. For both multivariable  
17 162 logistic regressions, the first step involved bivariate analyses (chi-square test or independent t-  
18 163 test). Explanatory variables whose significance was <0.10 were entered as candidate variables into  
19 164 a multivariable logistic model. Chi-square tests were then conducted between the care providers  
20 165 who believe they possess sufficient or insufficient knowledge in providing routine care and  
21 166 COVID-19 risk mitigation. Missing values will be excluded in the data analysis. No sensitivity  
22 167 analysis was conducted. The level of significance of statistical test was 0.05. All statistical analyses  
23 168 was conducted using IBM SPSS 21 for Windows<sup>24</sup>.  
24 169

### 170 **Patient and public involvement**

25 171 The design, or conduct, or reporting, or dissemination plans of our research were done without  
26 172 patient or the public involvement.  
27 173

## 174 **RESULTS**

28 175  
29 176 Final study sample consisted of 765 respondents (44.0% response rate) and was comparable with  
30 177 the population data in Hong Kong By-census 2016. Of the 765 participants, 53.5% (n=409) were  
31 178 women, 18.7% (n=143) were aged 64 and above, and 60.2% (n=459) were currently married.  
32 179 Information about the respondents and the recruitment process were detailed in a previous study  
33 180 in the same series<sup>17</sup>.  
34 181

### 182 **Characteristics of the home care recipients (N=345)**

35 183  
36 184 The study sample consisted of 192 care providers, who reported that they needed to provide care  
37 185 for 345 care recipients. Among these home care recipients, children represented 55.2% (being  
38 186 taken care of by parents), parents and parent-in-law represented 21.4% (being taken care of by  
39 187 children and children-in-law), while spouses accounted for 17.8%. (*Figure 1a*). As cited by the  
40 188 informal care providers, the main reasons for recipients' need of home care was due to extreme  
41 189 age (24.2%), had to stay at home due to COVID-19 epidemic (23.5%), recipient's chronic medical  
42 190 conditions (8.0%) and physical activities limitation (4.3%). Over half (53.8%) of home care  
43 191 recipients in the sample were considered as completely care dependent during the epidemic. Figure  
44 192 1b showed most of the dependent care recipient were aged 0-18 and aged 75 or above (chi-square  
45 193 p-value: p<0.001). Gender difference was not significant between dependent and non-dependent  
46 194 care recipient.  
47 195

### Who were the informal care provider during the COVID-19? (n=192)

In our study sample, one-quarter of respondents reported to have undertaken care responsibilities during the COVID-19 epidemic (Table 1). Notably, about 83.7% of informal home care providers were the primary home care providers and informal home care providers were predominantly female (67%, 129/192). Of informal home care providers, 44.8% were middle aged (45-64 years age), 38% were (73/192) aged 18-44 and 17.2% were aged 65 or above. Although full-time housewives represented nearly one-quarter of the informal care providers while 13.4% were unemployed or retired, more than 50% of informal home care providers were concurrently employed (44% were white collar employees). Multivariable logistic regression results indicated that *younger adults, female, married, housewives* were more likely to be informal home care providers during COVID 19 (Table 1)

Table 1. Factors associated with having informal home care responsibilities during the COVID-19 pandemic in Hong Kong (N=765)

N	Non-care provider (N=573)	Care provider (N=192)	p	AOR (95% Confident Interval)	p
Age			<0.001*		
18-24	12.0%	1.0%		Ref.	
25-44	30.9%	37.0%		5.34 (1.01 – 28.37)	0.049*
45-64	37.9%	44.8%		4.09 (0.76 – 22.14)	0.102
65 or more	19.2%	17.2%		3.63 (0.63 – 20.85)	0.148
Gender			<0.001*		
Male	51.1%	32.8%		Ref.	
Female	48.9%	67.2%		1.90 (1.29 – 2.82)	0.001*
Education attainment			0.125		
Primary level or below	8.1%	7.8%			
Secondary level	41.2%	49.5%			
Tertiary level	50.7%	42.7%			
Housing			0.370		
Public housing	28.4%	24.5%			
Subsidized housing	14.9%	12.0%			
Private housing	55.3%	62.5%			
Others	1.4%	1.0%			
Housing size			0.499		
Small (350ft or below)	22.1%	18.4%			
Medium (351 ft- 800ft)	63.0%	67.6%			
Large (801 ft. or above)	15.0%	14.0%			
Chronic disease?			0.155		
No	82.7%	78.1%			
Yes	17.3%	21.9%			
Marital status			<0.001*		

Currently unmarried	44.8%	25.0%		Ref.	
Currently married	55.2%	75.0%		2.20 (1.45 – 3.35)	<0.001*
Employment			<0.001*		
White collar	45.5%	44.4%		Ref.	
Blue collar	16.4%	18.7%		1.43 (0.88 – 2.32)	0.144
Housewives	8.8%	23.0%		1.89 (1.08 – 3.31)	0.026*
Students	8.1%	0.5%		0.38 (0.04 – 3.88)	0.412
Unemployed and retired	21.2%	13.4%		0.80 (0.43 – 1.50)	0.488
Household income			0.335		
<7999	10.0%	6.7%			
8000 – 19999	14.5%	12.8%			
20000 – 39999	25.2%	30.7%			
40000 or more	50.3%	49.7%			
*p<0.05 In the multivariable logistic regression, there were 2 missing values in <i>marital status</i> , and 11 missing values in <i>employment</i> .					

During this COVID-19 epidemic, nearly one in five of informal home care providers reported that they had to take personal leave from work or school to take care of their families. Informal home care providers who had taken personal leave were significantly more likely to be younger age (18-44 years of age), and were significantly more likely to have 2 or more dependent care recipients (chi-square p-value: <0.05). Although care provider's underlying chronic disease status, education attainment, housing types, and household income were not statistically significant.

The association between income levels and informal home care duties was statistically insignificant (chi-square p-value: >0.05). Yet, analysis showed home care providers from lower income subgroups (HKD 8000 – 19999) tended to have to be responsible for more than one care recipient when compare with the higher income counterparts (Figure 2). In addition, Female was found to be the predominant gender to have taken up the primary informal care provider's role (73.4%, chi-square p-value: <0.001).

\*There are 13 missing values in household income.

More than half of the informal home care providers were responsible for caring for more than one individual with nearly 20% (36/192) of respondents reporting that they needed to provide care to 3 or more household members. Of note, 64.7% care providers reported that there was at least 1 dependent care recipient under their caring duties; 32.3% and 47.6% care providers reported to be giving care to elderly family members (aged 65 or above) and children under the age of 18 or younger, respectively. Moreover, nearly 28% of households providing informal home care for fragile elderly while 7.4% had people with disabilities.

A statistically significant age association was found between care provider and recipient. Elderly care providers were more likely to provide home care to those 65 or older (p<0.05), while younger (aged 18-44) tend to provide care for aged 18 or younger care recipient (p<0.05). Younger care



242 providers (aged 18-44) were more likely to provide home care to 2 or more dependent care  
 243 recipient (31.4%) than the older age group (age 45-64: 21.0%, age 65 or above: 12.1%, p-value:  
 244 0.018). Meanwhile, other socio-demographic factor like gender, Education attainment, housing  
 245 factors of the care provider were not statistically significant. About 11.9% care providers reported  
 246 they had family members requiring care mainly due to their chronic disease condition. Non-  
 247 married care providers (26.7%; married: 7.1%) were more likely to provide care for household  
 248 members with chronic disease ( $p<0.001$ ).

### 250 **Physical, mental and social health of informal care providers during COVID-19**

251  
 252 Among the informal care provider, nearly 22% reported having an underlying chronic medical  
 253 condition themselves but this proportion did not significantly differ from the non-informal care  
 254 providers (17.3%) (Table 1). The perception of COVID-19's impact between provider and non-  
 255 care provider is shown in Table 2. Those providing informal home care showed no significant  
 256 differences in self-reported impacts on physical health, social life, and financial status, while  
 257 significant difference was found for self-report impact of mental health status when compared  
 258 between people with and without home care duties.

261 Table 2. Differences in perception between care provider and non-caregiver provider

	Non-care provider (N=573)	Care provider (N=192)	P
<b>Self-reported COVID-19 impact on physical, mental, social well-being</b>			
Believed COVID-19 had large effect on their physical health	50.3%	55.7%	0.190
Believed COVID-19 had large effect on their mental health	44.5%	53.6%	0.028*
Believed COVID-19 had large effect on their social life	70.7%	76.0%	0.152
Believed COVID-19 had large effect on their financial status	32.6%	35.4%	0.479
Believed COVID-19 had large effect on the Hong Kong	94.6%	93.8%	0.662
* $p<0.05$			

263  
 264  
 265 Notably, 53.9% reported that they had experienced additional strain in their care providers' duties.  
 266 The most common cited reasons for additional strains included COVID-19 health risk concern  
 267 (40.2%), increased time spent with care recipient (27.5%), and more things need to take care of  
 268 during the pandemic (21.6%). For changes of community services (e.g. day care center) utilization  
 269 that facilitated pre-COVID 19 care, 41 subjects reported to have used community services  
 270 regularly and among them 39% had stopped or decreased the use of the services due to the  
 271 epidemic.

272  
 273 Of the informal home care providers, 37.2% reported that their daily lives became more

challenging due to the need to care for their family during COVID-19 epidemic. Multivariable regression analysis, however, showed that these perceptions were not associated with age, sex and education attainment nor the number of care recipient. But providers who were having a dependent care recipient(s), and individuals having to take personal leave reported significantly increased difficulty in daily living ( $p<0.001$ ) (Table S1 in supplementary file).

### Care provider's perceived knowledge sufficiency

While nearly 90% of these home care providers believed that they had sufficient knowledge to provide routine care, only 50.5% believed that they had sufficient knowledge to manage the additional risk brought on by COVID-19 (Table S2 in supplementary file). Although various sociodemographic factors and care recipient characteristics were associated with care providers' perceived adequacy of knowledge for providing routine home care, there was no statistically significant difference for perceived adequacy of knowledge in COVID-19 risk mitigation by any sociodemographic or care recipient factors.

### Home environment to facilitate home care and household COVID-19 risk control

Among the study population ( $n=765$ ), only 32 subjects (4.2%) reported to have undergone home-quarantine/isolation during the COVID-19 epidemic. Among these subgroups, 23 (71.9%) took voluntary-based/self-imposed home isolation while 9 (28.1%) had to be home-bound due to government compulsory home isolation requirements. Reasons cited for quarantine due to recent travel abroad (41.9%) and in close contacts with confirmed patients (19.4%). Among the care providers, about 3.6% (7/192) reported that they had applied quarantine. Subjects were also asked about their preparation adequacy for potential home quarantine for 2 weeks. More than half of the subjects claimed they had sufficient masks, detergent, disposable gloves and sufficient independent rooms for isolation use. For the general household preparation, more than 80% participants have prepared alcohol rub, sufficient medicine and food and storage after COVID-19 epidemic started (Table 3).

Table 3. Self-reported household items for COVID-19 control during the epidemic (N=765)

	N (%)
Household preparation items for potential quarantine	
Masks	86.8%
Detergent	92.9%
Disposable gloves	51.9%
Sufficient independent room for isolation use	65.2%
General household preparation items	
Alcohol rub	95.2%
Basic medicine (for fevers and common cold)	92.4%
Food and water storage sufficient for 1 day	87.2%
Chronic disease medication enough for 1 week (N=241)	90.9%

1  
2  
3 309 Respondents reported awareness and knowledge of home quarantine instructions found most of  
4 310 the subjects agreed that family members living with quarantined patients should check their  
5 311 temperature daily (97.5%) and the quarantined subject should wear masks at home all the time  
6 312 (96.1%). However, only half of the subjects (51.3%) were able to answer that the ideal number of  
7 313 care providers for the person who is ill with COVID-19 should be only one. About 70% and 26%  
8 314 answered the ideal ratio of bleach solution for cleaning were 1:99 and 1:49 respectively. As to the  
9 315 ideal distance with the quarantine subject in the same room, 324 (42.4%) and 264 (34.6%) subjects  
10 316 answered 2 meters and 1 meter respectively.  
11  
12

## 13 317 14 318 **DISCUSSION**

15 319  
16 320 During large-scale public health emergencies, home care may be the only viable method of  
17 321 providing continuous health care due to disruption of services and transportation. In many regions  
18 322 around the world, health care systems have been overwhelmed by high caseloads of COVID-19  
19 323 patients with life-threatening conditions, necessitating greater reliance on informal home care  
20 324 providers. Home care during COVID-19 includes not only people caring for those with confirmed  
21 325 or suspected COVID-19; but also care for people with non-COVID-related conditions (for  
22 326 example the health maintaining support and essential life sustaining care), and their usual care  
23 327 responsibility for their family members. This is the first study to examine informal home care  
24 328 provision in high-income, urban context during a large-scale public health emergency. In our  
25 329 general population study sample of Hong Kong adults, approximately one-fourth reported to have  
26 330 provided informal home care during COVID-19 epidemic. In addition, about 20% among the  
27 331 caregivers reported that they have to provide care to 3 or more care recipients during the pandemic.  
28 332 In Hong Kong, many of the adults will live with their parents and children in the same household.  
29 333 Hence, the adult would have to take care of their parents and children. Consistent with previous  
30 334 literature<sup>8</sup>, females shouldered the main burden of being a primary home care provider. The  
31 335 COVID-19 pandemic presents a complex set of additional burdens on these home care providers.  
32 336 More than half of the informal home care providers reported additional mental strain during the  
33 337 epidemic.  
34  
35  
36  
37

38 339 Although the majority of informal home care providers believed that they had sufficient knowledge  
39 340 for their normal home care duties, we noted that some subgroups felt themselves to be  
40 341 insufficiently knowledgeable to provide even routine care. Previous studies have shown that older  
41 342 age and less educated care providers reported a higher mental burden from caregiving<sup>25,26</sup>.  
42 343 Consistent with this, we noted home care providers who were older, housewives, and with lower  
43 344 education and income were more likely to believe themselves as lacking knowledge to provide  
44 345 routine care. Moreover, those caring for dependent individuals (e.g. fragile elderly and disabled)  
45 346 felt inadequately knowledgeable, possibly due to heavy reliance on existing services for regular  
46 347 management of fragile elderly and people with disabilities by the government<sup>27</sup>. In contrast to the  
47 348 provision of routine informal home care, nearly half of the informal home care providers reported  
48 349 that they had insufficient knowledge to mitigate the additional health risks from the COVID-19  
49 350 epidemic and these findings were not associated with education or other factors.  
50  
51

52 351  
53 352 On top of the additional economic and knowledge burden brought on by the worldwide pandemic,  
54 353 approximately half of the care providers reported additional mental strain during the epidemic.  
55 354 The most common reasons cited were the concerns of risk of COVID-19 infection in family, the  
56  
57  
58  
59

1  
2  
3 355 longer duration of providing care and the additional caregiving tasks brought about from the  
4 356 pandemic. Nearly 40% of informal care provider reported that their caregiving duties had also  
5 357 caused increased difficulty in their daily life. Those reporting higher mental burden were often  
6 358 caring for dependent family members, and necessitating taking personal leave for the caregiving  
7 359 duties. Due to the COVID-19 pandemic, many community services like social community center<sup>28</sup>,  
8 360 day care center<sup>12</sup> and schools <sup>29</sup>were closed in Hong Kong. Hence, these home care providers with  
9 361 dependent care recipients require additional support services during public health emergencies.  
10 362 Furthermore, more than half of the care recipients were children and teenagers, who added to the  
11 363 caregiving burden during the nearly four-month, territory-wide school closures. The closure of  
12 364 schools and elderly services has curtailed health access during the epidemic with 40% of the care  
13 365 providers reporting to have ceased or reduced using those services. In addition, it was found that  
14 366 the caregiving burden was highest in the economically-active age group (aged 18 to 44). These  
15 367 individuals were often faced with a double burden of working and providing informal home care.  
16 368 Although government had subsidized the wages to employees<sup>30</sup>, further support should target this  
17 369 care provider group. For example, providing sufficient information and services in internet or  
18 370 smartphone app, as younger aged care provider was found to be using more internet and  
19 371 smartphone app as their main information source comparing to other aged group<sup>17</sup>.

20 372  
21 373 There were a few limitations in this study. First, the study recruitment relied on land-based  
22 374 telephone. Households without land-based telephone services would be missed. However, the  
23 375 penetration rate of the residential fixed line services in Hong Kong was 85.5% in December 2019<sup>31</sup>.  
24 376 In addition, our study population was comparable with the latest population Census in Hong Kong,  
25 377 which was generalizable to the general population. Furthermore, the study was conducted during  
26 378 the peak period of COVID-19 epidemic in Hong Kong. Citizens were encouraged to stay at home  
27 379 for work or daily activity. Hence, the respondents would be more compliant and attentive to the  
28 380 telephone survey <sup>32</sup>. Secondly, the cross-sectional study design can only demonstrate associations  
29 381 between patterns and social-demographic predictors, as causation cannot be attributed to the  
30 382 findings. Thirdly, this study might subject to reporting bias since data were self-reported, and data  
31 383 from non-respondents could not be obtained. Fourthly, our study did not further investigate the  
32 384 burdens, coping method and their perceived wellbeing of the care provider, which were potentially  
33 385 associated with the perceived difficulty of care giving. Lastly, for the sample size of the subjects  
34 386 who perceived lacking knowledge to provide routine care was small (n=20). Hence, advanced  
35 387 statistical analysis was not possible. Qualitative interviews might have revealed more rich and  
36 388 detailed insights.

37 389 Although the SARS-CoV-2/COVID-19 pandemic has engendered a huge amount of clinical,  
38 390 epidemiological and vaccine-related research, the socio-economic impact of COVID-19 has not  
39 391 yet been well-examined. Home care, being one of the crucial pillars in supporting people's health  
40 392 outside the formal healthcare setting during this pandemic, needs much stronger research and  
41 393 support from stakeholders at various levels<sup>33</sup>. In addition to research in formal healthcare services,  
42 394 better understanding of the challenges posed by the various home care settings (even informal  
43 395 settlements) is urgently required. This includes disease management in home care settings and  
44 396 strategies to optimize resources and support for informal care providers during global pandemics  
45 397 such as COVID-19. This study examined informal home care providers in a high-income Asian  
46 398 city during the early phase of the pandemic. However, the long-term implications on care  
47 399 providers, health outcomes of care recipients, and coping strategies of vulnerable people

400 (particularly those living alone) are largely unknown. Research in these areas is urgently needed  
401 to improve pandemic preparedness of national health systems.

402

## 403 **CONCLUSION**

404

405 This study explores home care situation in Hong Kong, an Asia metropolis in China which  
406 experienced the early phase of COVID-19 in 2020. Findings showed home care during pandemic  
407 can present a complex set of care recipient needs and providers' duties in densely-high-rise  
408 building based aging community with a high dependency ratio. The study also showed that  
409 younger workers with higher education and income had to bear the main burden of care for  
410 dependent care recipients during the epidemic but the heaviest routine care burden fell upon those  
411 with deficit resource. Governments should consider supplementing service support during large-  
412 scale public health emergencies when access to routine health care is disrupted. Policy should  
413 focus on continuous support to those informal care providers and their mental health needs during  
414 these public health emergencies.

415

## 416 **Figures**

417 Figure 1a. Characteristics of care provider-recipient relationship among all care recipients, as  
418 reported by informal care providers (N=345)

419 Figure 1b. Age distribution of dependent care receiver (who cannot live normally without  
420 caregivers' help)

421 Figure 2. The relationship between household income and informal home care duties

422

## 423 **Funding**

424 This work was supported by CCOUC-Oxford research support fund (#0008).

425

## 426 **Competing interests**

427 All authors have completed the ICMJE uniform disclosure form at  
428 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) and declare: no support from any organization for the  
429 submitted work; no financial relationships with any organizations that might have an interest in  
430 the submitted work in the previous three years; no other relationships or activities that could appear  
431 to have influenced the submitted work.

432

## 433 **Contributors**

434 EYYC, KKCH, ELYW, SYSW, & NG conceived the project. EYYC, ESKL, KKCH, ZH designed  
435 the study tool, obtained, validated, and cleaned the data. ESKL, ZH and JHK performed the data  
436 analysis. EYYC, ELYW, ESKL, JHK, HH and ZH involved in literature review and write up. All  
437 authors contributed to the manuscript drafting, review, revision and approval of the final  
438 manuscript. KKCH, ESKL, HH SYSW and ZH provided administrative and operational support.

1  
2  
3 439 The corresponding author attests that all listed authors meet authorship criteria and that no others  
4 440 meeting the criteria have been omitted.

5  
6 441

7  
8 442 **Ethical Approval**

9  
10 443 Verbal consent was obtained from the participant and ethics approval and consent procedure of  
11 444 the study was reviewed and obtained from the Survey and Behavioral Research Ethics  
12 445 Committee at The Chinese University of Hong Kong (SBRE-19-498).

13  
14 446

15  
16 447 **Data sharing statement**

17  
18 448 No additional data are available.

19  
20 449

21  
22 450 **Word count: 3903**

23  
24 451

25  
26 452 **Licence**

27  
28 453 I, the Submitting Author has the right to grant and does grant on behalf of all authors of the  
29 454 Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive  
30 455 licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has  
31 456 agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US  
32 457 Federal Government officers or employees acting as part of their official duties; on a worldwide,  
33 458 perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd (“BMJ”) its licensees and  
34 459 where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the  
35 460 Work in BMJ Open and any other BMJ products and to exploit all rights, as set out in our  
36 461 licence.

37  
38  
39 462 The Submitting Author accepts and understands that any supply made under these terms is made  
40 463 by BMJ to the Submitting Author unless you are acting as an employee on behalf of your  
41 464 employer or a postgraduate student of an affiliated institution which is paying any applicable  
42 465 article publishing charge (“APC”) for Open Access articles. Where the Submitting Author  
43 466 wishes to make the Work available on an Open Access basis (and intends to pay the relevant  
44 467 APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence  
45 468 – details of these licences and which Creative Commons licence will apply to this Work are set  
46 469 out in our licence referred to above.

47  
48  
49 470

50  
51 471

52  
53  
54  
55  
56  
57  
58  
59  
60

472 **Reference**

- 473
- 474 1. World Health Organization. Home care for patients with COVID-19 presenting with mild
- 475 symptoms and management of contacts. Who. 2020.
- 476 2. World Health Organization. Home-based and long-term care: Home care issues and
- 477 evidence [Internet]. Geneva; 1999. Available from:
- 478 [https://apps.who.int/iris/bitstream/handle/10665/66096/WHO\\_HSC\\_LTH\\_99.2.pdf?sequence=1&isAllowed=y](https://apps.who.int/iris/bitstream/handle/10665/66096/WHO_HSC_LTH_99.2.pdf?sequence=1&isAllowed=y)
- 479
- 480 3. Li J, Song Y. Formal and Informal Care. In: Gu D, Dupre ME, editors. Encyclopedia of
- 481 Gerontology and Population Aging [Internet]. Cham: Springer International Publishing;
- 482 2019. p. 1–8. Available from: [https://doi.org/10.1007/978-3-319-69892-2\\_847-1](https://doi.org/10.1007/978-3-319-69892-2_847-1)
- 483 4. Dow J, Robinson J, Robalino S, Finch T, McColl E, Robinson L. How best to assess quality
- 484 of life in informal carers of people with dementia; A systematic review of existing outcome
- 485 measures. PLoS ONE. 2018.
- 486 5. Amer Nordin A, Mohd Hairi F, Choo WY, Hairi NN. Care Recipient Multimorbidity and
- 487 Health Impacts on Informal Caregivers: A Systematic Review. Gerontologist. 2019;
- 488 6. Johnson S, Bacsu J, Abeykoon H, McIntosh T, Jeffery B, Novik N. No Place Like Home:
- 489 A Systematic Review of Home Care for Older Adults in Canada. Can J Aging. 2018;
- 490 7. Lou WV. Financial Impacts of Family Caregiving: an Investigation of the Moderating
- 491 Effects of Workplace Accommodative Measures and Domestic Helpers [Internet]. 2017.
- 492 Available from:
- 493 [https://www.pico.gov.hk/doc/en/research\\_report\(PDF\)/2015\\_A8\\_031\\_16A\\_Final\\_Report](https://www.pico.gov.hk/doc/en/research_report(PDF)/2015_A8_031_16A_Final_Report_Dr_Lou.pdf)
- 494 [\\_Dr\\_Lou.pdf](https://www.pico.gov.hk/doc/en/research_report(PDF)/2015_A8_031_16A_Final_Report_Dr_Lou.pdf)
- 495 8. Ho SC, ACM C, JTF L, J W. A study of informal caregivers and the association of
- 496 caregiving status with health and quality of life. Hong Kong Med J [Internet]. 2007;13(Supp
- 497 5):S4-7. Available from: <https://www.hkmj.org/system/files/hkm0710sp5p4.pdf>
- 498 9. Stein RA. COVID-19 and rationally layered social distancing. International Journal of
- 499 Clinical Practice. 2020.
- 500 10. Wilder-Smith A, Chiew CJ, Lee VJ. Can we contain the COVID-19 outbreak with the same
- 501 measures as for SARS? The Lancet Infectious Diseases. 2020.
- 502 11. Education Bureau of the government of Hong Kong Special Administration. Deferral of
- 503 Class Resumption for All Schools Together, We Fight the Virus [Internet]. 2020 [cited 2020
- 504 May 5]. Available from: [https://www.edb.gov.hk/attachment/en/sch-admin/admin/about-](https://www.edb.gov.hk/attachment/en/sch-admin/admin/about-sch/diseases-prevention/edb_20200331_eng.pdf)
- 505 [sch/diseases-prevention/edb\\_20200331\\_eng.pdf](https://www.edb.gov.hk/attachment/en/sch-admin/admin/about-sch/diseases-prevention/edb_20200331_eng.pdf)
- 506 12. Government of the Hong Kong Special Administrative Region. LNY welfare services set
- 507 [Internet]. news.gov.hk. 2020 [cited 2020 Apr 24]. Available from:
- 508 [https://www.news.gov.hk/eng/2020/01/20200127/20200127\\_233955\\_845.html](https://www.news.gov.hk/eng/2020/01/20200127/20200127_233955_845.html)
- 509 13. New.gov.hk. Quarantine measures enhanced [Internet]. 2020 [cited 2020 May 7]. Available
- 510 from: [https://www.news.gov.hk/eng/2020/03/20200317/20200317\\_202509\\_713.html](https://www.news.gov.hk/eng/2020/03/20200317/20200317_202509_713.html)
- 511 14. Centre for Health Protection of the Government of Hong Kong Special Administrative
- 512 Region. List of buildings of the confinees under mandatory quarantine according to Cap.
- 513 599C of Hong Kong Laws [Internet]. 2020 [cited 2020 May 7]. Available from:
- 514 [https://www.chp.gov.hk/files/pdf/599c\\_tc.pdf](https://www.chp.gov.hk/files/pdf/599c_tc.pdf)
- 515 15. Chan EYY, Gobat N, Kim JH, Newnham EA, Huang Z, Hung H, et al. Informal home care
- 516 providers: the forgotten health-care workers during the COVID-19 pandemic. The Lancet.
- 517 2020.

- 1  
2  
3 518 16. Census and Statistics Department of Government of Hong Kong Special Administrative  
4 519 Region. Domestic Households in Hong Kong [Internet]. 2016 [cited 2020 Apr 24].  
5 520 Available from: <https://www.byccensus2016.gov.hk/en/Snapshot-04.html>  
6 521  
7 521 17. Chan EYY, Huang Z, Lo ESK, Hung KKC, Wong ELY, Wong SYS. Sociodemographic  
8 522 predictors of health risk perception, attitude and behavior practices associated with Health-  
9 523 Emergency Disaster Risk Management for biological hazards: the case of COVID-19  
10 524 pandemic in Hong Kong, SAR China. *Int J Environ Res Public Health*. 2020;17(11):3869.  
11 525 18. Chan EY-Y, Cheng CK-Y, Tam GC-H, Huang Z, Lee PY. Willingness of future A/H7N9  
12 526 influenza vaccine uptake: A cross-sectional study of Hong Kong community. *Vaccine*  
13 527 [Internet]. 2015 Sep 11;33(38):4737–40. Available from:  
14 528 <http://www.sciencedirect.com/science/article/pii/S0264410X15010063>  
15 529 19. Chan EYY, Cheng CKY, Tam G, Huang Z, Lee P. Knowledge, attitudes, and practices of  
16 530 Hong Kong population towards human A/H7N9 influenza pandemic preparedness, China,  
17 531 2014. *BMC Public Health* [Internet]. 2015;15:943. Available from:  
18 532 <http://www.biomedcentral.com/1471-2458/15/943>  
19 533 20. Tam G, Huang Z, Chan EYY. Household preparedness and preferred communication  
20 534 channels in public health emergencies: A cross-sectional survey of residents in an asian  
21 535 developed Urban city. *Int J Environ Res Public Health*. 2018;15(8).  
22 536 21. Chan, Ying Yang Emily, Wong CS. Public health prevention hierarchy in disaster context.  
23 537 In: Chan, Ying Yang Emily, Shaw R, editors. *Public health and disasters - Health*  
24 538 *Emergency and Disaster Risk Management in Asia*. Tokyo: Springer; 2020. p. 7–17.  
25 539 22. Centre for Health Protection of the government of Hong Kong Special Administrative  
26 540 Region. Communicable Diseases [Internet]. 2020 [cited 2020 May 7]. Available from:  
27 541 <https://www.chp.gov.hk/en/resources/464/102466.html>  
28 542 23. Census and Statistics Department of the Government of the Hong Kong Special  
29 543 Administrative Region. Main Table (By-Census Results) [Internet]. [cited 2019 Oct 31].  
30 544 Available from: <https://www.byccensus2016.gov.hk/en/bc-mt.html>  
31 545 24. IBM. SPSS Statistics 21.0 Available for Download [Internet]. 2020 [cited 2020 May 27].  
32 546 Available from: [https://www.ibm.com/support/pages/spss-statistics-210-available-](https://www.ibm.com/support/pages/spss-statistics-210-available-download)  
33 547 [download](https://www.ibm.com/support/pages/spss-statistics-210-available-download)  
34 548 25. Chow EO wah, Ho HCY. Caregiver strain, age, and psychological well-being of older  
35 549 spousal caregivers in Hong Kong. *J Soc Work*. 2015;  
36 550 26. Oedekoven M, Amin-Kotb K, Gellert P, Balke K, Kuhlmeier A, Schnitzer S. Associations  
37 551 between Informal Caregivers' Burden and Educational Level. *GeroPsych: The Journal of*  
38 552 *Gerontopsychology and Geriatric Psychiatry*. 2019.  
39 553 27. Social Welfare Department. Integrated Home Care Services [Internet]. 2015 [cited 2020 Apr  
40 554 24]. Available from: [https://www.swd.gov.hk/doc/elderly/IHCS\(Nov2015\).pdf](https://www.swd.gov.hk/doc/elderly/IHCS(Nov2015).pdf)  
41 555 28. Government of the Hong Kong Special Administrative Region. Public service arrangements  
42 556 updated [Internet]. [news.gov.hk](http://news.gov.hk). 2020 [cited 2020 Apr 24]. Available from:  
43 557 [https://www.news.gov.hk/eng/2020/03/20200322/20200322\\_131634\\_065.html?type=ticker](https://www.news.gov.hk/eng/2020/03/20200322/20200322_131634_065.html?type=ticker)  
44 558 er  
45 559 29. Government of the Hong Kong Special Administrative Region. No delay in fight against  
46 560 virus: CE [Internet]. [news.gov.hk](http://news.gov.hk). 2020 [cited 2020 Apr 24]. Available from:  
47 561 [https://www.news.gov.hk/chi/2020/01/20200125/20200125\\_191553\\_178.html?type=category&name=covid19&tl=t](https://www.news.gov.hk/chi/2020/01/20200125/20200125_191553_178.html?type=category&name=covid19&tl=t)  
48 562  
49 563 30. News.gov.hk. Gov't unveils employment measures. 2020 Apr 20 [cited 2020 May 19];  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



- 1  
2  
3 564 Available from:  
4 565 [https://www.news.gov.hk/eng/2020/04/20200420/20200420\\_175816\\_569.html](https://www.news.gov.hk/eng/2020/04/20200420/20200420_175816_569.html)  
5 566 31. Office of the Communications Authority Key Communications Statistics of the government  
6 567 of Hong Kong Special Administrative Region. Key Communications Statistics [Internet].  
7 568 2019 [cited 2020 May 28]. Available from:  
8 569 [https://www.ofca.gov.hk/en/data\\_statistics/data\\_statistics/key\\_stat/](https://www.ofca.gov.hk/en/data_statistics/data_statistics/key_stat/)  
9 570 32. Office of the Communications Authority. Key Communications Statistics [Internet]. 2012  
10 571 [cited 2020 Apr 24]. Available from:  
11 572 [https://www.ofca.gov.hk/en/data\\_statistics/data\\_statistics/key\\_stat/](https://www.ofca.gov.hk/en/data_statistics/data_statistics/key_stat/)  
12 573 33. Chan EY, Gobat N, Hung H, MacGregor H, Wong E. Health-Emergency and Disaster  
13 574 Management (Health-EDRM) Technical Brief Series: A review on implications of home  
14 575 care on biological hazard. 2020.  
15 576  
16 577  
17 578

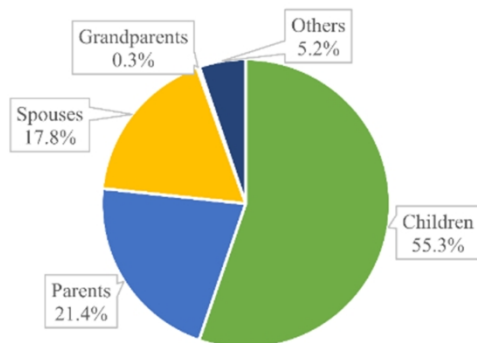


Fig. 1a

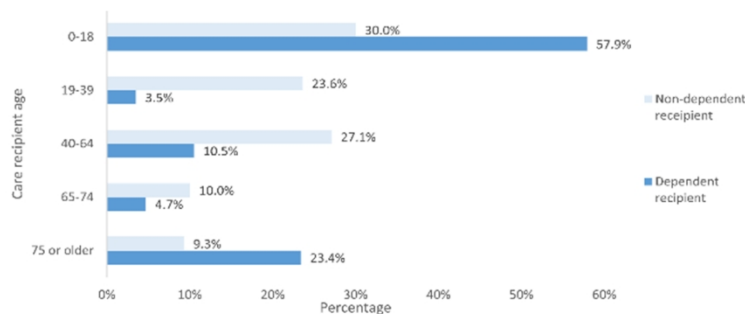


Fig. 1b

Figure 1a. Characteristics of care provider-recipient relationship among all care recipients, as reported by informal care providers (N=345)

Figure 1b. Age distribution of dependent care receiver (who cannot live normally without caregivers' help)

101x76mm (600 x 600 DPI)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

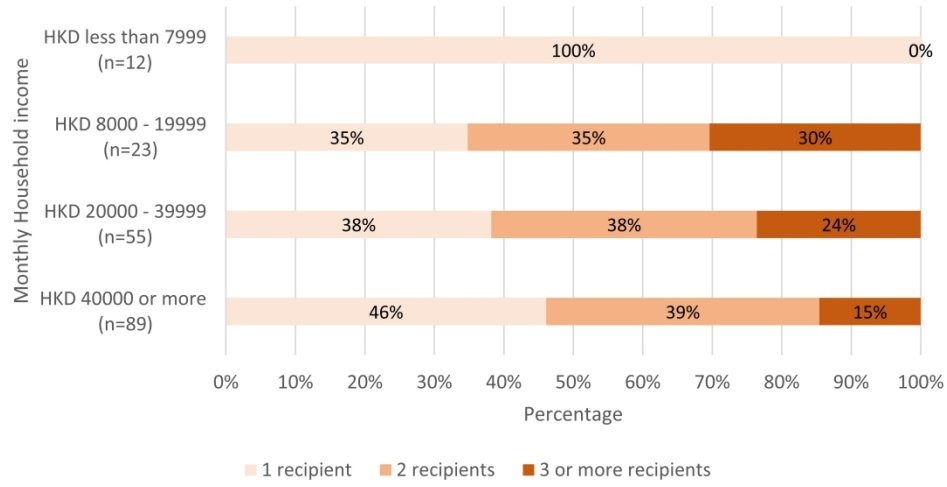


Figure 2. The relationship between household income and informal home care duties

177x88mm (768 x 768 DPI)

**Table of contents**

Page

Table S1. Factors associated with self-perceived increased difficulty in daily living .....2

Table S2. Sociodemographic predictors for care providers who believed to have adequate knowledge for routine care and COVID infection control.....5

For peer review only

Table S1. Factors associated with self-perceived increased difficulty in daily living

	No	Yes	p	AOR (LB-UB)	p
N	120	71			
<b>Socio-demographic</b>					
Age <sup>a</sup>			0.306		
18-44	34.2%	43.7%			
45-64	49.2%	38.0%			
65 or more	16.7%	18.3%			
Gender			0.441		
Male	35.0%	29.6%			
Female	65.0%	70.4%			
Education attainment			0.356		
Primary level or below	10.0%	4.2%			
Secondary level	48.3%	52.1%			
Tertiary level	41.7%	43.7%			
Occupation			0.903		
White collar	44.8%	44.3%			
Blue collar (including services and sales)	19.0%	17.1%			
Housewives	21.6%	25.7%			
Students	0.9%	0.0%			
Unemployed or retired	13.8%	12.9%			
Housing			0.703		
Public housing	25.8%	21.1%			
Subsidized housing	13.3%	9.9%			
Private housing (including independent villa)	60.0%	67.6%			
Others	0.8%	1.4%			
Household income			0.422		
<7999	4.5%	10.6%			
8000 – 19999	14.3%	10.6%			
20000 – 39999	30.4%	30.3%			
40000 or more	50.9%	48.5%			
Housing size			0.397		
Small (350ft or below)	16.2%	22.4%			
Medium (351 ft- 800ft)	67.6%	67.2%			
Large (801 ft. or above)	16.2%	10.4%			
Chronic disease condition			0.616		
No	79.2%	76.1%			
Yes	20.8%	23.9%			
Marital status			0.001		
Unmarried (including divorced or widow)	32.5%	11.3%		Ref.	
Married	67.5%	88.7%		2.81 (0.98 – 8.09)	0.055

Having sufficient knowledge to take care their family members			0.463		
Not sure or No	9.6%	13.0%			
Yes	90.4%	87.0%			
<b>Characteristics of the care recipient</b>					
Number of care recipient			0.797		
1 recipient	47.5%	43.7%			
2 recipients	35.0%	35.2%			
3 or more recipients	17.5%	21.1%			
Family member as fragile elderly or disabilities			0.958		
No	68.6%	69.0%			
Yes (with either one)	31.4%	31.0%			
Children were the care recipients			0.075		
No	42.5%	29.6%		Ref.	
Yes	57.5%	70.4%		0.83 (0.34 – 2.05)	0.688
Spouse was the care recipient			0.148		
No	73.3%	63.4%			
Yes	26.7%	36.6%			
Parents or parents-in-law were the care recipients*			0.033		
No	65.8%	80.3%		Ref.	
Yes	34.2%	19.7%		0.23 (0.08- 0.70)	0.009
Family member who were dependent recipients *			<0.001		
No	49.1%	13.0%		Ref.	
Yes	50.9%	87.0%		6.38 (2.69 – 15.14)	<0.001
Family member received care due to staying at home during COVID-19 outbreak ^			0.053		
No	81.9%	69.6%		Ref.	
Yes	18.1%	30.4%		1.70 (0.70 – 4.13)	0.238
Family member who receive care mainly due to their chronic condition			0.709		
No	88.8%	87.0%			
Yes	11.2%	13.0%			
<b>The effect brought by COVID-19</b>					
Stopped or decrease the use of community services during COVID-19 outbreak+			0.007		
No	95.8%	84.5%		Ref.	

	Yes	4.2%	15.5%		3.22 (0.73 – 14.19)	0.122
	Need to take personal leave for caregiving responsibility*			<0.001		
	No	92.4%	63.4%		Ref.	
	Yes	7.6%	36.6%		7.15 (2.44 – 20.91)	<0.001
<p>+Using Fisher's exact test, ^p&lt;0.10, * p&lt;0.05,  <sup>a</sup>The age group "18-24" and "25-44" were collapsed  In the multivariable logistic regression, there were 7 missing values in variable <i>family member who were dependent recipients</i>, 2 missing values in <i>stopped or decrease the use of community services during COVID-19 outbreak</i>, 2 missing values in <i>need to take personal leave for caregiving responsibility</i>, 7 missing values in <i>stay at home during COVID-19 outbreak</i>, and 1 missing value in <i>perceived increased difficulty in daily live</i></p>						

Or peer review only

Table S2. Sociodemographic predictors for care providers who believed to have adequate knowledge for routine care and COVID infection control

N	Knowledge for routine care			Knowledge of COVID-19 risk mitigation		
	Not enough knowledge	Enough knowledge	p	Not enough knowledge	Enough knowledge	p
<b>Socio-demographic details</b>						
Age <sup>ab</sup>			0.036*			0.349
18-44	25.0%	39.6%		43.2%	33.0%	
45-64	35.0%	45.1%		41.1%	48.5%	
65 or more	40.0%	15.2%		15.8%	18.6%	
Gender			0.455			0.958
Male	40.0%	31.7%		32.6%	33.0%	
Female	60.0%	68.3%		67.4%	67.0%	
Education attainment			<0.001*			0.160
Primary or below	30.0%	4.3%		10.5%	5.2%	
Secondary	45.0%	49.4%		52.6%	46.4%	
Tertiary	25.0%	46.3%		36.8%	48.5%	
Marital status <sup>a</sup>			0.786			0.453
Non-married	20.0%	25.0%		27.4%	22.7%	
Married	80.0%	75.0%		72.6%	77.3%	
Housing <sup>a</sup>			0.236			0.897
Public housing	40.0%	22.0%		23.2%	25.8%	
Subsidized housing	15.0%	12.2%		13.7%	10.3%	
Private housing (including independent villa)	45.0%	65.2%		62.1%	62.9%	
Others	0.0%	0.6%		1.1%	1.0%	
Living density (household size / number of people) <sup>a</sup>			0.900			0.428
<200 ft per ppl	62.5%	60.9%		65.5%	59.8%	
200 ft or more per ppl	37.5%	39.1%		34.5%	40.2%	
Main information channel <sup>a</sup>			0.653			0.249
Television	50.0%	34.1%		38.9%	34.0%	
Internet or smartphone app	45.0%	57.9%		56.8%	55.7%	



Others (newspaper, radio)	5.0%	7.9%		4.2%	10.3%	
Housing size <sup>a</sup>			0.104			0.547
Small (350ft or below)	31.3%	16.7%		20.7%	16.3%	
Medium (351 ft-800ft)	68.8%	67.3%		67.8%	67.4%	
Large (801 ft. or above)	0.0%	16.0%		11.5%	16.3%	
Family income group <sup>a</sup>			<0.001*			0.323
<7999	27.8%	4.5%		5.8%	7.5%	
8000 – 19999	11.1%	13.5%		12.8%	12.9%	
20000 – 39999	50.0%	27.6%		37.2%	24.7%	
40000 or more	11.1%	54.5%		44.2%	54.8%	
Employment <sup>a</sup>			0.010*			0.699
White collar	15.0%	49.1%		44.6%	44.2%	
Blue collar (including services and sales)	20.0%	17.6%		18.5%	18.9%	
Students	0.0%	0.0%		25.0%	21.1%	
Housewives	45.0%	20.1%		1.1%	0.0%	
Unemployment and retired	20.0%	13.2%		10.9%	15.8%	
<b>Care recipient characteristics</b>						
Children were the care recipients			0.059			0.528
No	55.0%	33.5%		35.8%	40.2%	
Yes	45.0%	66.5%		64.2%	59.8%	
Spouse was the care recipient			0.723			0.594
No	65.0%	68.9%		71.6%	68.0%	
Yes	35.0%	31.1%		28.4%	32.0%	
Parents or parents-in-law were the care recipients			0.597			0.480
No	65.0%	70.7%		73.7%	69.1%	
Yes	35.0%	29.3%		26.3%	30.9%	
Family members were dependent recipients			0.044*			0.817
No	15.0%	37.8%		34.8%	36.5%	

	Yes	85.0%	62.2%		65.2%	63.5%	
Members were fragile elderly or disabilities				0.040*			0.709
	No	47.4%	70.6%		70.2%	67.7%	
	Yes	52.6%	29.4%		29.8%	32.3%	
<sup>a</sup> Fisher's exact test was performed for analysis about "knowledge for routine care" <sup>b</sup> The age group "18-24" and "25-44" were combined as the age group "18-24" only have 2 subjects * $p < 0.05$							

For peer review only

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5
		(b) Describe any methods used to examine subgroups and interactions	5
		(c) Explain how missing data were addressed	5
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	5
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5,7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5,7
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	6-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-11

		(b) Report category boundaries when continuous variables were categorized	6-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-13
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Characteristics and well-being of urban informal home care providers during COVID-19 pandemic: a population-based study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-041191.R2
Article Type:	Original research
Date Submitted by the Author:	07-Oct-2020
Complete List of Authors:	<p>Chan, Emily; The Chinese University of Hong Kong, JC School of Public Health and Primary Care; University of Oxford, Nuffield Department of Medicine</p> <p>Lo, Eugene; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Huang, Zhe; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Kim, Jean ; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Hung, Heidi; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Hung, Kevin KC; Chinese University of Hong Kong, Accident and Emergency Medicine Academic Unit</p> <p>Wong, Eliza LY; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Wong, Samuel; The Chinese University of Hong Kong, JC School of Public Health and Primary Care</p> <p>Gobat, Nina; University of Oxford, Nuffield Department of Medicine</p>
<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	General practice / Family practice
Keywords:	Public health < INFECTIOUS DISEASES, PRIMARY CARE, PUBLIC HEALTH

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

# Characteristics and well-being of urban informal home care providers during COVID-19 pandemic: a population-based study

Emily Ying Yang Chan<sup>1,2,3\*</sup>, Eugene Siu Kai Lo<sup>1,3</sup>, Zhe Huang<sup>1,3</sup>, Jean H Kim<sup>3</sup>, Heidi Hung<sup>1,3</sup>, Kevin Kei Ching Hung<sup>1,4</sup>, Eliza Lai Yi Wong<sup>3</sup>, Samuel Yeung Shan Wong<sup>3</sup>, Nina Gobat<sup>5</sup>

<sup>1</sup> Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), The Chinese University of Hong Kong, Hong Kong, China; emily.chan@cuhk.edu.hk; euglks@cuhk.edu.hk; huangzhe@cuhk.edu.hk

<sup>2</sup> Nuffield Department of Medicine, University of Oxford, Oxford OX37BN, UK

<sup>3</sup> JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, China;

<sup>4</sup> Accident & Emergency Medicine Academic Unit, The Chinese University of Hong Kong, Prince of Wales Hospital, Hong Kong SAR, China; kevin.hung@cuhk.edu.hk

<sup>5</sup> Primary Health Care, Nuffield Department of Medicine, University of Oxford. nina.gobat@phc.ac.ox.uk

\* Correspondence: emily.chan@cuhk.edu.hk; Tel.: +852-2252-8702

## ABSTRACT

### Objectives

Globally, the COVID-19 pandemic has overwhelmed many health care systems and individuals are unable to access routine clinical care during lockdowns. Informal home care, care provided by non-healthcare professionals, increases the community's health care capacity during pandemics. There is, however, limited research about the characteristics of informal home care providers and the challenges they face during such public health emergencies.

### Design

A random, cross-sectional, population-based telephone survey study was conducted to examine patterns of home care, characteristics of informal home care providers and the challenges of these care providers during this pandemic.

### Setting

Data were collected from 22 March to 1 April 2020 in Hong Kong, China.

### Participants

A population representative study sample of Chinese-speaking adults (n=765) was interviewed.

### Primary and secondary outcome measures

The study examined the characteristics of informal home care providers, and the characteristics and health care requirements of the care recipients. The study also examined providers' self-perceived knowledge to provide routine home care as well as COVID-19 risk reduction care. Respondents were asked about mental health related to COVID-19.

### Results

Of the respondents, 25.1% of 765 provided informal home care during the studied COVID-19 pandemic period. Of informal home care providers, 18.4% of respondents took leave from school/work during the epidemic to provide care that included fragile elderly and small children.

1  
2  
3 48 These care providers tended to be younger-aged, female, and housewives. Approximately half of  
4 49 care providers reported additional mental strain and 37.2 % reported of challenges in daily living  
5 50 during epidemic. Although most informal home care providers felt competent to provide routine  
6 51 care, 49.5% felt inadequately prepared to cope with the additional health risks of COVID-19.  
7 52

### 8 53 Conclusion

9 54 During public health emergencies, heavy reliance on informal home health care providers  
10 55 necessitates better understanding of their specific needs and increased government services to  
11 56 support informal home care.  
12 57

13 58 **Keywords:** Informal home care, health and well-being, COVID 19, Urban, Asia, Hong Kong  
14 59

15 60 **Abstract word count: 300**  
16 61  
17 62



### 63 **Strengths and limitation of this study**

64 In a city affected in the early stages of the COVID-19 pandemic, this study was the first to  
65 highlight the impact and added burden of care experienced by informal home care providers  
66 among the general population.

67 This telephone-based study was conducted during the peak period of COVID-19 epidemic in  
68 Hong Kong, so the citizen would be more compliant and attentive to the telephone survey as they  
69 were encouraged to stay at home for work or daily activity.

70 The cross-sectional design cannot draw a conclusion on any cause-effect relationship.

71 this study might subject to reporting bias since data were self-reported, and data from non-  
72 respondents could not be obtained.

73

### 74 **INTRODUCTION**

75

76 Home care is regarded as one of the major care models to address medical needs for patients and  
77 vulnerable populations during COVID-19 pandemic<sup>1</sup>. As described by the World Health  
78 Organization (WHO)<sup>2</sup>, home care aims to provide high quality and cost-effective care to  
79 individuals that will enable them to maintain their independence and the highest possible quality  
80 of life. While formal home care providers are usually remunerated workers from medical  
81 authorities or registered organizations, informal home care providers are usually family members  
82 or others who provide unpaid care to those in need<sup>3</sup>. The typical profile of individuals who require  
83 home care are patients with chronic diseases or mental conditions, individuals with disabilities,  
84 young children, the elderly and other vulnerable individuals who live alone. Up to the present, the  
85 published literature has mainly examined the quality of life of older adults, the care recipients, the  
86 mental health of the care providers<sup>4-6</sup> and experience of informal home care providers under non-  
87 emergency health situations<sup>7,8</sup>.

88

89 During the COVID-19 pandemic, in an attempt to reduce the surge of patients requiring hospital  
90 care, many countries have implemented epidemic control measures<sup>9</sup> to limit activities outside the  
91 home such as closure of non-essential services. Moreover, countries have relied heavily on home  
92 quarantine for suspected COVID-19 patients with mild-symptoms in order to maintain resilience  
93 of the national health system<sup>1,9,10</sup>. In Hong Kong, in conjunction with prohibitions on mass  
94 gatherings, closure of recreational centers, schools and community services<sup>11,12</sup>, a mandatory 14-  
95 days quarantine was issued for those who entered into Hong Kong from outside its borders<sup>13</sup>. This  
96 resulted in 13,649 individuals under compulsory home quarantine from 13 Mar to 26 Mar 2020<sup>14</sup>.  
97 In such a public health emergency, informal care may be the only care option for people in need<sup>15</sup>.  
98 There have been no published studies of informal care providers during extreme events or during  
99 population-level health emergencies. Hence, the impacts on informal home care providers from  
100 the closure of community services and limited access to healthcare services during the COVID-19  
101 are unknown.

102

1  
2  
3 103 According to the Hong Kong 2016 By-census, one-fourth of households had children aged under  
4 104 15 while and one-third household reported having at least one elderly household member<sup>16</sup>.  
5 105 Combined, these households were particularly in need of home care even in ordinary setting,  
6 106 accounting for 27.2% of the whole Hong Kong population. The likely heavy reliance on informal  
7 107 home care during a pandemic emergency in Hong Kong allows examination of the prevalence and  
8 108 special needs of informal home care providers. This study aimed to identify the pattern of informal  
9 109 home care, characteristics of informal home care providers and their challenges in Hong Kong  
10 110 during the COVID-19 epidemic. The study also seeks to examine the knowledge levels and level  
11 111 of preparation for the home quarantine among these care providers and the recipients of their care  
12 112 in Hong Kong.  
13 113

## 14 114 **METHODS**

### 15 115

### 16 116 **Study design and study population**

17 117  
18 118 A cross-sectional, population-based telephone survey was conducted from 22 March to 1 April  
19 119 2020 during the peak of local COVID-19 pandemic. The computerized Random Digit Dialing  
20 120 (RDD) method was used for each of Hong Kong's 18 districts to randomly select a representative  
21 121 sample. The survey methods and the sample size estimation have been previously detailed<sup>17</sup>. It  
22 122 was designed on the basis of literature review and previous research experience<sup>18-21</sup>. The study  
23 123 only includes respondents who were 18 years old or older, and speak Cantonese.  
24 124

### 25 125 **The study instruments**

26 126  
27 127 A self-reported, semi-structured Chinese questionnaire was used for data collection<sup>17</sup>. The data  
28 128 collected included the subjects' perception, knowledge, preparedness, their home care experience  
29 129 if available toward and during the COVID-19 pandemic. Since the home care recipients could  
30 130 include a wide range of different groups (e.g. healthy children due to the closure of schools), care  
31 131 providers were identified through one of the questions in the questionnaire "Do you currently need  
32 132 to look after member(s) of your family and relatives' daily needs (like your children/parents)  
33 133 during COVID-19 epidemic?". Besides the experience and situations of their care duties during  
34 134 the COVID-19, the characteristics of the care recipients under their care were also investigated.  
35 135 Care recipients' age, sex, relationship with the care provider, the reason for the receiving care and  
36 136 their dependency were recorded. Care providers were also asked if they were the primary care  
37 137 providers for their recipients (defined as having the major responsibility in caregiving duties) and  
38 138 if their care recipient was dependent on them (defined as inability to maintain activities of daily  
39 139 living without care provider assistance). All self-reported home care providers in this study were  
40 140 confirmed to be informal care provider.  
41 141

42 142 Care providers were asked if they felt that they possessed sufficient knowledge about routine care  
43 143 and COVID-19 risk mitigation. A 5-point Likert scale was used to assess physical, mental, social  
44 144 and other related health impact (ranging from 1= no impact to 5= maximum impact). Respondents  
45 145 were asked about their home care experience, risks perception, household capacity to provide care  
46 146 and home care challenges that they experienced. The instrument also asked about knowledge of  
47 147 infection control during a home quarantine. Specifically, the respondents were asked about their  
48 148 knowledge of infection control in home context such as *the ratio of bleach solution for cleaning*  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 149 (*1.99 ratio for normal cleaning and 1.49 for cleaning vomit, excreta or secretion*<sup>22</sup>), the  
4 150 *recommended distance for with the quarantine subjects (at least 1 meter*<sup>22</sup>).  
5 151

### 6 152 **Statistical analysis**

8 153 Descriptive statistics of the study sample were presented with chi-square tests to examine  
9 154 comparability of the study sample with the Hong Kong general census population<sup>23</sup>. Socio-  
10 155 demographic pattern analyses of respondents who might have care-providing responsibilities, the  
11 156 home care recipients, and the context of care provision during the COVID-19, were conducted.  
12 157 Chi-square test was conducted for comparing the perception toward COVID-19 between care  
13 158 provider and non-care provider subjects. Multivariable logistic regression analysis was conducted  
14 159 to compare the sociodemographic predictors between care providers and non-care providers. In  
15 160 addition, logistic regression analysis was conducted to understand how the socio-demographic of  
16 161 the care provider and their care responsibilities may affect their daily living. For both multivariable  
17 162 logistic regressions, the first step involved bivariate analyses (chi-square test or independent t-  
18 163 test). Explanatory variables whose significance was <0.10 were entered as candidate variables into  
19 164 a multivariable logistic model. Chi-square tests were then conducted between the care providers  
20 165 who believed they possess sufficient or insufficient knowledge in providing routine care and  
21 166 COVID-19 risk mitigation. Missing values will be excluded in the data analysis. No sensitivity  
22 167 analysis was conducted. The level of significance of statistical test was 0.05. All statistical analyses  
23 168 were conducted using IBM SPSS 21 for Windows<sup>24</sup>.  
24 169

### 27 170 **Patient and public involvement**

28 171 The design, or conduct, or reporting, or dissemination plans of our research were done without  
29 172 patient or the public involvement.  
30 173

## 32 174 **RESULTS**

33 175  
34 176 Final study sample consisted of 765 respondents (44.0% response rate) and was comparable with  
35 177 the population data in Hong Kong By-census 2016. Of the 765 participants, 53.5% (n=409) were  
36 178 women, 18.7% (n=143) were aged 64 and above, and 60.2% (n=459) were currently married.  
37 179 Information about the respondents and the recruitment process were detailed in a previous study  
38 180 in the same series<sup>17</sup>.  
39 181

### 41 182 **Characteristics of the home care recipients (N=345)**

42 183  
43 184 The study sample consisted of 192 care providers, who reported that they needed to provide care  
44 185 for 345 care recipients. Among these home care recipients, children represented 55.2% (being  
45 186 taken care of by parents), parents and parent-in-law represented 21.4% (being taken care of by  
46 187 children and children-in-law), while spouses accounted for 17.8%. (*Figure 1a*). As cited by the  
47 188 informal care providers, the main reasons for recipients' need of home care was due to extreme  
48 189 age (24.2%), had to stay at home due to COVID-19 epidemic (23.5%), recipient's chronic medical  
49 190 conditions (8.0%) and physical activities limitation (4.3%). Over half (53.8%) of home care  
50 191 recipients in the sample were considered as completely care dependent during the epidemic. Figure  
51 192 1b showed most of the dependent care recipient were aged 0-18 and aged 75 or above (chi-square  
52 193 p-value: p<0.001). Gender difference was not significant between dependent and non-dependent  
53 194 care recipient.  
54 195  
55 196  
56 197  
57  
58  
59  
60

### Who were the informal care provider during the COVID-19? (n=192)

In our study sample, one-quarter of respondents reported to have undertaken care responsibilities during the COVID-19 epidemic (Table 1). Notably, about 83.7% of informal home care providers were the primary home care providers and informal home care providers were predominantly female (67%, 129/192). Of informal home care providers, 44.8% were middle aged (45-64 years' age), 38% were (73/192) aged 18-44 and 17.2% were aged 65 or above. Although full-time housewives represented nearly one-quarter of the informal care providers while 13.4% were unemployed or retired, more than 50% of informal home care providers were concurrently employed (44% were white collar employees). Multivariable logistic regression results indicated that *younger adults, female, married, housewives* were more likely to be informal home care providers during COVID 19 (Table 1)

Table 1. Factors associated with having informal home care responsibilities during the COVID-19 pandemic in Hong Kong (N=765)

N	Non-care provider (N=573)	Care provider (N=192)	p	AOR (95% Confident Interval)	p
Age			<0.001*		
18-24	12.0%	1.0%		Ref.	
25-44	30.9%	37.0%		5.34 (1.01 – 28.37)	0.049*
45-64	37.9%	44.8%		4.09 (0.76 – 22.14)	0.102
65 or more	19.2%	17.2%		3.63 (0.63 – 20.85)	0.148
Gender			<0.001*		
Male	51.1%	32.8%		Ref.	
Female	48.9%	67.2%		1.90 (1.29 – 2.82)	0.001*
Education attainment			0.125		
Primary level or below	8.1%	7.8%			
Secondary level	41.2%	49.5%			
Tertiary level	50.7%	42.7%			
Housing			0.370		
Public housing	28.4%	24.5%			
Subsidized housing	14.9%	12.0%			
Private housing	55.3%	62.5%			
Others	1.4%	1.0%			
Housing size			0.499		
Small (350ft or below)	22.1%	18.4%			
Medium (351 ft- 800ft)	63.0%	67.6%			
Large (801 ft. or above)	15.0%	14.0%			
Chronic disease?			0.155		
No	82.7%	78.1%			
Yes	17.3%	21.9%			
Marital status			<0.001*		

Currently unmarried	44.8%	25.0%		Ref.	
Currently married	55.2%	75.0%		2.20 (1.45 – 3.35)	<0.001*
Employment			<0.001*		
White collar	45.5%	44.4%		Ref.	
Blue collar	16.4%	18.7%		1.43 (0.88 – 2.32)	0.144
Housewives	8.8%	23.0%		1.89 (1.08 – 3.31)	0.026*
Students	8.1%	0.5%		0.38 (0.04 – 3.88)	0.412
Unemployed and retired	21.2%	13.4%		0.80 (0.43 – 1.50)	0.488
Household income			0.335		
<7999	10.0%	6.7%			
8000 – 19999	14.5%	12.8%			
20000 – 39999	25.2%	30.7%			
40000 or more	50.3%	49.7%			
*p<0.05 In the multivariable logistic regression, there were 2 missing values in <i>marital status</i> , and 11 missing values in <i>employment</i> .					

During this COVID-19 epidemic, nearly one in five of informal home care providers reported that they had to take personal leave from work or school to take care of their families. Informal home care providers who had taken personal leave were significantly more likely to be younger age (18-44 years of age), and were significantly more likely to have 2 or more dependent care recipients (chi-square p-value: <0.05). Although care provider's underlying chronic disease status, education attainment, housing types, and household income were not statistically significant.

The association between income levels and informal home care duties was statistically insignificant (chi-square p-value: >0.05). Yet, analysis showed home care providers from lower income subgroups (HKD 8000 – 19999) tended to have to be responsible for more than one care recipient when compare with the higher income counterparts (Figure 2). In addition, Female was found to be the predominant gender to have taken up the primary informal care provider's role (73.4%, chi-square p-value: <0.001).

\*There are 13 missing values in household income.

More than half of the informal home care providers were responsible for caring for more than one individual with nearly 20% (36/192) of respondents reporting that they needed to provide care to 3 or more household members. Of note, 64.7% care providers reported that there was at least 1 dependent care recipient under their caring duties; 32.3% and 47.6% care providers reported to be giving care to elderly family members (aged 65 or above) and children under the age of 18 or younger, respectively. Moreover, nearly 28% of households providing informal home care for fragile elderly while 7.4% had people with disabilities.

A statistically significant age association was found between care provider and recipient. Elderly care providers were more likely to provide home care to those 65 or older (p<0.05), while younger (aged 18-44) tend to provide care for aged 18 or younger care recipient (p<0.05). Younger care

242 providers (aged 18-44) were more likely to provide home care to 2 or more dependent care  
 243 recipient (31.4%) than the older age group (age 45-64: 21.0%, age 65 or above: 12.1%, p-value:  
 244 0.018). Meanwhile, other socio-demographic factor like gender, Education attainment, housing  
 245 factors of the care provider were not statistically significant. About 11.9% care providers reported  
 246 they had family members requiring care mainly due to their chronic disease condition. Non-  
 247 married care providers (26.7%; married: 7.1%) were more likely to provide care for household  
 248 members with chronic disease ( $p<0.001$ ).

### 250 **Physical, mental and social health of informal care providers during COVID-19**

251  
 252 Among the informal care provider, nearly 22% reported having an underlying chronic medical  
 253 condition themselves but this proportion did not significantly differ from the non-informal care  
 254 providers (17.3%) (Table 1). The perception of COVID-19's impact between provider and non-  
 255 care provider is shown in Table 2. Those providing informal home care showed no significant  
 256 differences in self-reported impacts on physical health, social life, and financial status, while  
 257 significant difference was found for self-report impact of mental health status when compared  
 258 between people with and without home care duties.

261 Table 2. Differences in perception between care provider and non-care provider

	Non-care provider (N=573)	Care provider (N=192)	P
<b>Self-reported COVID-19 impact on physical, mental, social well-being</b>			
Believed COVID-19 had large effect on their physical health	50.3%	55.7%	0.190
Believed COVID-19 had large effect on their mental health	44.5%	53.6%	0.028*
Believed COVID-19 had large effect on their social life	70.7%	76.0%	0.152
Believed COVID-19 had large effect on their financial status	32.6%	35.4%	0.479
Believed COVID-19 had large effect on the Hong Kong	94.6%	93.8%	0.662
* $p<0.05$			

263  
 264  
 265 Notably, 53.9% reported that they had experienced additional strain in their care providers' duties.  
 266 The most commonly cited reasons for additional strains included COVID-19 health risk concern  
 267 (40.2%), increased time spent with care recipient (27.5%), and more things need to take care of  
 268 during the pandemic (21.6%). For changes of community services (e.g. day care center) utilization  
 269 that facilitated pre-COVID 19 care, 41 subjects reported to have used community services  
 270 regularly and among them 39% had stopped or decreased the use of the services due to the  
 271 epidemic.

272  
 273 Of the informal home care providers, 37.2% reported that their daily lives became more

challenging due to the need to care for their family during COVID-19 epidemic. Multivariable regression analysis, however, showed that these perceptions were not associated with age, sex and education attainment nor the number of care recipient. But providers who were having a dependent care recipient(s), and individuals having to take personal leave reported significantly increased difficulty in daily living ( $p<0.001$ ) (Table S1 in supplementary file).

### Care provider's perceived knowledge sufficiency

While nearly 90% of these home care providers believed that they had sufficient knowledge to provide routine care, only 50.5% believed that they had sufficient knowledge to manage the additional risk brought on by COVID-19 (Table S2 in supplementary file). Although various sociodemographic factors and care recipient characteristics were associated with care providers' perceived adequacy of knowledge for providing routine home care, there was no statistically significant difference for perceived adequacy of knowledge in COVID-19 risk mitigation by any sociodemographic or care recipient factors.

### Home environment to facilitate home care and household COVID-19 risk control

Among the study population ( $n=765$ ), only 32 subjects (4.2%) reported to have undergone home-quarantine/isolation during the COVID-19 epidemic. Among these subgroups, 23 (71.9%) took voluntary-based/self-imposed home isolation while 9 (28.1%) had to be home-bound due to government compulsory home isolation requirements. Reasons cited for quarantine due to recent travel abroad (41.9%) and in close contacts with confirmed patients (19.4%). Among the care providers, about 3.6% (7/192) reported that they had applied quarantine. Subjects were also asked about their preparation adequacy for potential home quarantine for 2 weeks. More than half of the subjects claimed they had sufficient masks, detergent, disposable gloves and sufficient independent rooms for isolation use. For the general household preparation, more than 80% participants have prepared alcohol rub, sufficient medicine and food and storage after COVID-19 epidemic started (Table 3).

Table 3. Self-reported household items for COVID-19 control during the epidemic (N=765)

	N (%)
Household preparation items for potential quarantine	
Masks	86.8%
Detergent	92.9%
Disposable gloves	51.9%
Sufficient independent room for isolation use	65.2%
General household preparation items	
Alcohol rub	95.2%
Basic medicine (for fevers and common cold)	92.4%
Food and water storage sufficient for 1 day	87.2%
Chronic disease medication enough for 1 week (N=241)	90.9%

1  
2  
3 309 Respondents reported awareness and knowledge of home quarantine instructions found most of  
4 310 the subjects agreed that family members living with quarantined patients should check their  
5 311 temperature daily (97.5%) and the quarantined subject should wear masks at home all the time  
6 312 (96.1%). However, only half of the subjects (51.3%) were able to answer that the ideal number of  
7 313 care providers for the person who is ill with COVID-19 should be only one. About 70% and 26%  
8 314 answered the ideal ratio of bleach solution for cleaning were 1:99 and 1:49 respectively. As to the  
9 315 ideal distance with the quarantine subject in the same room, 324 (42.4%) and 264 (34.6%) subjects  
10 316 answered 2 meters and 1 meter respectively.  
11  
12

## 13 317 14 318 **DISCUSSION**

15 319  
16 320 During large-scale public health emergencies, home care may be the only viable method of  
17 321 providing continuous health care due to disruption of services and transportation. In many regions  
18 322 around the world, health care systems have been overwhelmed by high caseloads of COVID-19  
19 323 patients with life-threatening conditions, necessitating greater reliance on informal home care  
20 324 providers. Home care providers during COVID-19 include not only people caring for those with  
21 325 confirmed or suspected COVID-19; but also care for people with non-COVID-related conditions  
22 326 (for example the health maintaining support and essential life sustaining care), and their usual care  
23 327 responsibility for their family members. This is the first study to examine informal home care  
24 328 provision in high-income, urban context during a large-scale public health emergency. In our  
25 329 general population study sample of Hong Kong adults, approximately one-fourth reported to have  
26 330 provided informal home care during COVID-19 epidemic. In addition, about 20% among the  
27 331 caregivers reported that they have to provide care to 3 or more care recipients during the pandemic.  
28 332 In Hong Kong, many of the adults will live with their parents and children in the same household.  
29 333 Hence, the adult would have to take care of their parents and children. Consistent with previous  
30 334 literature<sup>8</sup>, females shouldered the main burden of being a primary home care provider. The  
31 335 COVID-19 pandemic presents a complex set of additional burdens on these home care providers.  
32 336 More than half of the informal home care providers reported additional mental strain during the  
33 337 epidemic.  
34  
35  
36  
37

38 339 Although the majority of informal home care providers believed that they had sufficient knowledge  
39 340 for their normal home care duties, we noted that some subgroups felt themselves to be  
40 341 insufficiently knowledgeable to provide even routine care. Previous studies have shown that older  
41 342 age and less educated care providers reported a higher mental burden from caregiving<sup>25,26</sup>.  
42 343 Consistent with this, we noted home care providers who were older, housewives, and with lower  
43 344 education and income were more likely to believe themselves as lacking knowledge to provide  
44 345 routine care. Moreover, those caring for dependent individuals (e.g. fragile elderly and disabled)  
45 346 felt inadequately knowledgeable, possibly due to heavy reliance on existing services for regular  
46 347 management of fragile elderly and people with disabilities by the government<sup>27</sup>. In contrast to the  
47 348 provision of routine informal home care, nearly half of the informal home care providers reported  
48 349 that they had insufficient knowledge to mitigate the additional health risks from the COVID-19  
49 350 epidemic and these findings were not associated with education or other factors.  
50  
51

52 351  
53 352 On top of the additional economic and knowledge burden brought on by the worldwide pandemic,  
54 353 approximately half of the care providers reported additional mental strain during the epidemic.  
55 354 The most common reasons cited were the concerns of risk of COVID-19 infection in family, the  
56  
57  
58  
59



1  
2  
3 355 longer duration of providing care and the additional caregiving tasks brought about from the  
4 356 pandemic. Nearly 40% of informal care provider reported that their caregiving duties had also  
5 357 caused increased difficulty in their daily life. Those reporting higher mental burden were often  
6 358 caring for dependent family members, and necessitating taking personal leave for the caregiving  
7 359 duties. Due to the COVID-19 pandemic, many community services like social community center<sup>28</sup>,  
8 360 day care center<sup>12</sup> and schools<sup>29</sup> were closed in Hong Kong. Hence, these home care providers with  
9 361 dependent care recipients require additional support services during public health emergencies.  
10 362 Furthermore, more than half of the care recipients were children and teenagers, who added to the  
11 363 caregiving burden during the nearly four-month, territory-wide school closures. The closure of  
12 364 schools and elderly services has curtailed health access during the epidemic with 40% of the care  
13 365 providers reporting to have ceased or reduced using those services. In addition, it was found that  
14 366 the caregiving burden was highest in the economically-active age group (aged 18 to 44). These  
15 367 individuals were often faced with a double burden of working and providing informal home care.  
16 368 Although government had subsidized the wages to employees<sup>30</sup>, further support should target this  
17 369 care provider group. For example, providing sufficient information and services in internet or  
18 370 smartphone app, as younger aged care provider was found to be using more internet and  
19 371 smartphone app as their main information source comparing to other aged group<sup>17</sup>.

20 372  
21 373 There were a few limitations in this study. First, the study recruitment relied on land-based  
22 374 telephone. Households without land-based telephone services would be missed. However, the  
23 375 penetration rate of the residential fixed line services in Hong Kong was 85.5% in December  
24 376 2019<sup>31</sup>. In addition, our study population was comparable with the latest population Census in Hong  
25 377 Kong, which was generalizable to the general population. Furthermore, the study was conducted  
26 378 during the peak period of COVID-19 epidemic in Hong Kong. Citizens were encouraged to stay  
27 379 at home for work or daily activity. Hence, the respondents would be more compliant and attentive  
28 380 to the telephone survey<sup>32</sup>. Secondly, the cross-sectional study design can only demonstrate  
29 381 associations between patterns and social-demographic predictors, as causation cannot be attributed  
30 382 to the findings. Thirdly, this study might subject to reporting bias since data were self-reported,  
31 383 and data from non-respondents could not be obtained. Fourthly, our study did not further  
32 384 investigate the burdens, coping method and their perceived wellbeing of the care provider, which  
33 385 were potentially associated with the perceived difficulty of care giving. Lastly, for the sample size  
34 386 of the subjects who perceived lacking knowledge to provide routine care was small (n=20). Hence,  
35 387 advanced statistical analysis was not possible. Qualitative interviews might have revealed more  
36 388 rich and detailed insights.

37 389 Although the SARS-CoV-2/COVID-19 pandemic has engendered a huge amount of clinical,  
38 390 epidemiological and vaccine-related research, the socio-economic impact of COVID-19 has not  
39 391 yet been well-examined. Home care, being one of the crucial pillars in supporting people's health  
40 392 outside the formal healthcare setting during this pandemic, needs much stronger research and  
41 393 support from stakeholders at various levels<sup>33</sup>. In addition to research in formal healthcare services,  
42 394 better understanding of the challenges posed by the various home care settings (even informal  
43 395 settlements) is urgently required. This includes disease management in home care settings and  
44 396 strategies to optimize resources and support for informal care providers during global pandemics  
45 397 such as COVID-19. This study examined informal home care providers in a high-income Asian  
46 398 city during the early phase of the pandemic. However, the long-term implications on care  
47 399 providers, health outcomes of care recipients, and coping strategies of vulnerable people

400 (particularly those living alone) are largely unknown. Research in these areas is urgently needed  
401 to improve pandemic preparedness of national health systems.

## 402 403 **CONCLUSION**

404  
405 This study explores home care situation in Hong Kong, an Asia metropolis in China which  
406 experienced the early phase of COVID-19 in 2020. Findings showed home care during pandemic  
407 can present a complex set of care recipient needs and providers' duties in densely-high-rise  
408 building based aging community with a high dependency ratio. The study also showed that  
409 younger workers with higher education and income had to bear the main burden of care for  
410 dependent care recipients during the epidemic but the heaviest routine care burden fell upon those  
411 with deficit resource. Governments should consider supplementing service support during large-  
412 scale public health emergencies when access to routine health care is disrupted. Policy should  
413 focus on continuous support to those informal care providers and their mental health needs during  
414 these public health emergencies.

## 415 416 **Figures**

417 Figure 1a. Characteristics of care provider-recipient relationship among all care recipients, as  
418 reported by informal care providers (N=345)

419 Figure 1b. Age distribution of dependent care receiver (who cannot live normally without  
420 caregivers' help)

421 Figure 2. The relationship between household income and informal home care duties

## 422 423 **Questionnaire**

424 [http://www.ccoouc.ox.ac.uk/\\_asset/file/questionnaire-of-home-care.pdf](http://www.ccoouc.ox.ac.uk/_asset/file/questionnaire-of-home-care.pdf)

## 425 426 **Funding**

427 This work was supported by CCOUC-Oxford research support fund (#0008).

## 428 429 **Competing interests**

430 All authors have completed the ICMJE uniform disclosure form at  
431 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) and declare: no support from any organization for the  
432 submitted work; no financial relationships with any organizations that might have an interest in  
433 the submitted work in the previous three years; no other relationships or activities that could appear  
434 to have influenced the submitted work.

## 435 436 **Contributors**

1  
2  
3 437 EYYC, KKCH, ELYW, SYSW, & NG conceived the project. EYYC, ESKL, KKCH, ZH designed  
4 438 the study tool, obtained, validated, and cleaned the data. ESKL, ZH and JHK performed the data  
5 439 analysis. EYYC, ELYW, ESKL, JHK, HH and ZH involved in literature review and write up. All  
6 440 authors contributed to the manuscript drafting, review, revision and approval of the final  
7 441 manuscript. KKCH, ESKL, HH SYSW and ZH provided administrative and operational support.  
8 442 The corresponding author attests that all listed authors meet authorship criteria and that no others  
9 443 meeting the criteria have been omitted.  
10  
11  
12  
13

444

### 445 **Ethical Approval**

446 Verbal consent was obtained from the participant and ethics approval and consent procedure of  
447 the study was reviewed and obtained from the Survey and Behavioral Research Ethics  
448 Committee at The Chinese University of Hong Kong (SBRE-19-498).  
449

450

### 451 **Data sharing statement**

452 No additional data are available.  
453

454

### 455 **Word count: 3903**

456

### 457 **Licence**

458 I, the Submitting Author has the right to grant and does grant on behalf of all authors of the  
459 Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive  
460 licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has  
461 agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US  
462 Federal Government officers or employees acting as part of their official duties; on a worldwide,  
463 perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd (“BMJ”) its licensees and  
464 where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the  
465 Work in BMJ Open and any other BMJ products and to exploit all rights, as set out in our  
466 licence.

467 The Submitting Author accepts and understands that any supply made under these terms is made  
468 by BMJ to the Submitting Author unless you are acting as an employee on behalf of your  
469 employer or a postgraduate student of an affiliated institution which is paying any applicable  
470 article publishing charge (“APC”) for Open Access articles. Where the Submitting Author  
471 wishes to make the Work available on an Open Access basis (and intends to pay the relevant  
472 APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence  
– details of these licences and which Creative Commons licence will apply to this Work are set  
out in our licence referred to above.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

473  
474

For peer review only

## Reference

1. World Health Organization. Home care for patients with COVID-19 presenting with mild symptoms and management of contacts. Who. 2020.
2. World Health Organization. Home-based and long-term care: Home care issues and evidence [Internet]. Geneva; 1999. Available from: [https://apps.who.int/iris/bitstream/handle/10665/66096/WHO\\_HSC\\_LTH\\_99.2.pdf?sequence=1&isAllowed=y](https://apps.who.int/iris/bitstream/handle/10665/66096/WHO_HSC_LTH_99.2.pdf?sequence=1&isAllowed=y)
3. Li J, Song Y. Formal and Informal Care. In: Gu D, Dupre ME, editors. Encyclopedia of Gerontology and Population Aging [Internet]. Cham: Springer International Publishing; 2019. p. 1–8. Available from: [https://doi.org/10.1007/978-3-319-69892-2\\_847-1](https://doi.org/10.1007/978-3-319-69892-2_847-1)
4. Dow J, Robinson J, Robalino S, Finch T, McColl E, Robinson L. How best to assess quality of life in informal carers of people with dementia; A systematic review of existing outcome measures. PLoS ONE. 2018.
5. Amer Nordin A, Mohd Hairi F, Choo WY, Hairi NN. Care Recipient Multimorbidity and Health Impacts on Informal Caregivers: A Systematic Review. Gerontologist. 2019;
6. Johnson S, Bacsu J, Abeykoon H, McIntosh T, Jeffery B, Novik N. No Place Like Home: A Systematic Review of Home Care for Older Adults in Canada. Can J Aging. 2018;
7. Lou WV. Financial Impacts of Family Caregiving: an Investigation of the Moderating Effects of Workplace Accommodative Measures and Domestic Helpers [Internet]. 2017. Available from: [https://www.pico.gov.hk/doc/en/research\\_report\(PDF\)/2015\\_A8\\_031\\_16A\\_Final\\_Report\\_Dr\\_Lou.pdf](https://www.pico.gov.hk/doc/en/research_report(PDF)/2015_A8_031_16A_Final_Report_Dr_Lou.pdf)
8. Ho SC, ACM C, JTF L, J W. A study of informal caregivers and the association of caregiving status with health and quality of life. Hong Kong Med J [Internet]. 2007;13(Supp 5):S4-7. Available from: <https://www.hkmj.org/system/files/hkm0710sp5p4.pdf>
9. Stein RA. COVID-19 and rationally layered social distancing. International Journal of Clinical Practice. 2020.
10. Wilder-Smith A, Chiew CJ, Lee VJ. Can we contain the COVID-19 outbreak with the same measures as for SARS? The Lancet Infectious Diseases. 2020.
11. Education Bureau of the government of Hong Kong Special Administration. Deferral of Class Resumption for All Schools Together, We Fight the Virus [Internet]. 2020 [cited 2020 May 5]. Available from: [https://www.edb.gov.hk/attachment/en/sch-admin/admin/about-sch/diseases-prevention/edb\\_20200331\\_eng.pdf](https://www.edb.gov.hk/attachment/en/sch-admin/admin/about-sch/diseases-prevention/edb_20200331_eng.pdf)
12. Government of the Hong Kong Special Administrative Region. LNY welfare services set [Internet]. news.gov.hk. 2020 [cited 2020 Apr 24]. Available from: [https://www.news.gov.hk/eng/2020/01/20200127/20200127\\_233955\\_845.html](https://www.news.gov.hk/eng/2020/01/20200127/20200127_233955_845.html)
13. New.gov.hk. Quarantine measures enhanced [Internet]. 2020 [cited 2020 May 7]. Available from: [https://www.news.gov.hk/eng/2020/03/20200317/20200317\\_202509\\_713.html](https://www.news.gov.hk/eng/2020/03/20200317/20200317_202509_713.html)
14. Centre for Health Protection of the Government of Hong Kong Special Administrative Region. List of buildings of the confinees under mandatory quarantine according to Cap. 599C of Hong Kong Laws [Internet]. 2020 [cited 2020 May 7]. Available from: [https://www.chp.gov.hk/files/pdf/599c\\_tc.pdf](https://www.chp.gov.hk/files/pdf/599c_tc.pdf)
15. Chan EYY, Gobat N, Kim JH, Newnham EA, Huang Z, Hung H, et al. Informal home care providers: the forgotten health-care workers during the COVID-19 pandemic. The Lancet. 2020.

- 1  
2  
3 521 16. Census and Statistics Department of Government of Hong Kong Special Administrative  
4 522 Region. Domestic Households in Hong Kong [Internet]. 2016 [cited 2020 Apr 24].  
5 523 Available from: <https://www.byccensus2016.gov.hk/en/Snapshot-04.html>  
6  
7 524 17. Chan EYY, Huang Z, Lo ESK, Hung KKC, Wong ELY, Wong SYS. Sociodemographic  
8 525 predictors of health risk perception, attitude and behavior practices associated with Health-  
9 526 Emergency Disaster Risk Management for biological hazards: the case of COVID-19  
10 527 pandemic in Hong Kong, SAR China. *Int J Environ Res Public Health*. 2020;17(11):3869.  
11 528 18. Chan EY-Y, Cheng CK-Y, Tam GC-H, Huang Z, Lee PY. Willingness of future A/H7N9  
12 529 influenza vaccine uptake: A cross-sectional study of Hong Kong community. *Vaccine*  
13 530 [Internet]. 2015 Sep 11;33(38):4737–40. Available from:  
14 531 <http://www.sciencedirect.com/science/article/pii/S0264410X15010063>  
15 532 19. Chan EYY, Cheng CKY, Tam G, Huang Z, Lee P. Knowledge, attitudes, and practices of  
16 533 Hong Kong population towards human A/H7N9 influenza pandemic preparedness, China,  
17 534 2014. *BMC Public Health* [Internet]. 2015;15:943. Available from:  
18 535 <http://www.biomedcentral.com/1471-2458/15/943>  
19  
20 536 20. Tam G, Huang Z, Chan EYY. Household preparedness and preferred communication  
21 537 channels in public health emergencies: A cross-sectional survey of residents in an asian  
22 538 developed Urban city. *Int J Environ Res Public Health*. 2018;15(8).  
23  
24 539 21. Chan, Ying Yang Emily, Wong CS. Public health prevention hierarchy in disaster context.  
25 540 In: Chan, Ying Yang Emily, Shaw R, editors. *Public health and disasters - Health*  
26 541 *Emergency and Disaster Risk Management in Asia*. Tokyo: Springer; 2020. p. 7–17.  
27 542 22. Centre for Health Protection of the government of Hong Kong Special Administrative  
28 543 Region. Communicable Diseases [Internet]. 2020 [cited 2020 May 7]. Available from:  
29 544 <https://www.chp.gov.hk/en/resources/464/102466.html>  
30 545 23. Census and Statistics Department of the Government of the Hong Kong Special  
31 546 Administrative Region. Main Table (By-Census Results) [Internet]. [cited 2019 Oct 31].  
32 547 Available from: <https://www.byccensus2016.gov.hk/en/bc-mt.html>  
33 548 24. IBM. SPSS Statistics 21.0 Available for Download [Internet]. 2020 [cited 2020 May 27].  
34 549 Available from: [https://www.ibm.com/support/pages/spss-statistics-210-available-](https://www.ibm.com/support/pages/spss-statistics-210-available-download)  
35 550 [download](https://www.ibm.com/support/pages/spss-statistics-210-available-download)  
36  
37 551 25. Chow EO wah, Ho HCY. Caregiver strain, age, and psychological well-being of older  
38 552 spousal caregivers in Hong Kong. *J Soc Work*. 2015;  
39 553 26. Oedekoven M, Amin-Kotb K, Gellert P, Balke K, Kuhlmeier A, Schnitzer S. Associations  
40 554 between Informal Caregivers' Burden and Educational Level. *Geropsych: The Journal of*  
41 555 *Gerontopsychology and Geriatric Psychiatry*. 2019.  
42 556 27. Social Welfare Department. Integrated Home Care Services [Internet]. 2015 [cited 2020 Apr  
43 557 24]. Available from: [https://www.swd.gov.hk/doc/elderly/IHCS\(Nov2015\).pdf](https://www.swd.gov.hk/doc/elderly/IHCS(Nov2015).pdf)  
44 558 28. Government of the Hong Kong Special Administrative Region. Public service arrangements  
45 559 updated [Internet]. [news.gov.hk](http://news.gov.hk). 2020 [cited 2020 Apr 24]. Available from:  
46 560 [https://www.news.gov.hk/eng/2020/03/20200322/20200322\\_131634\\_065.html?type=tick-](https://www.news.gov.hk/eng/2020/03/20200322/20200322_131634_065.html?type=ticker)  
47 561 [er](https://www.news.gov.hk/eng/2020/03/20200322/20200322_131634_065.html?type=ticker)  
48 562 29. Government of the Hong Kong Special Administrative Region. No delay in fight against  
49 563 virus: CE [Internet]. [news.gov.hk](http://news.gov.hk). 2020 [cited 2020 Apr 24]. Available from:  
50 564 [https://www.news.gov.hk/chi/2020/01/20200125/20200125\\_191553\\_178.html?type=categ-](https://www.news.gov.hk/chi/2020/01/20200125/20200125_191553_178.html?type=category&name=covid19&tl=t)  
51 565 [ory&name=covid19&tl=t](https://www.news.gov.hk/chi/2020/01/20200125/20200125_191553_178.html?type=category&name=covid19&tl=t)  
52  
53 566 30. [News.gov.hk](http://news.gov.hk). Gov't unveils employment measures. 2020 Apr 20 [cited 2020 May 19];  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 567 Available from:  
4 568 [https://www.news.gov.hk/eng/2020/04/20200420/20200420\\_175816\\_569.html](https://www.news.gov.hk/eng/2020/04/20200420/20200420_175816_569.html)  
5  
6 569 31. Office of the Communications Authority Key Communications Statistics of the government  
7 570 of Hong Kong Special Administrative Region. Key Communications Statistics [Internet].  
8 571 2019 [cited 2020 May 28]. Available from:  
9 572 [https://www.ofca.gov.hk/en/data\\_statistics/data\\_statistics/key\\_stat/](https://www.ofca.gov.hk/en/data_statistics/data_statistics/key_stat/)  
10 573 32. Office of the Communications Authority. Key Communications Statistics [Internet]. 2012  
11 574 [cited 2020 Apr 24]. Available from:  
12 575 [https://www.ofca.gov.hk/en/data\\_statistics/data\\_statistics/key\\_stat/](https://www.ofca.gov.hk/en/data_statistics/data_statistics/key_stat/)  
13 576 33. Chan EY, Gobat N, Hung H, MacGregor H, Wong E. Health-Emergency and Disaster  
14 577 Management (Health-EDRM) Technical Brief Series: A review on implications of home  
15 578 care on biological hazard. 2020.  
16 579  
17  
18 580  
19 581

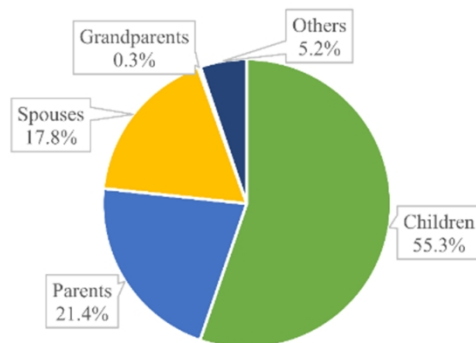


Fig. 1a

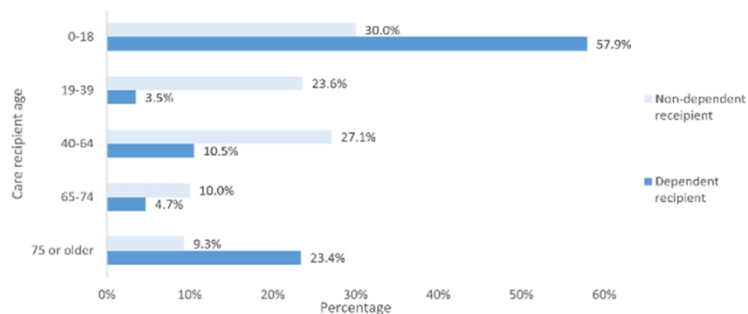


Fig. 1b

Figure 1a. Characteristics of care provider-recipient relationship among all care recipients, as reported by informal care providers (N=345)

Figure 1b. Age distribution of dependent care receiver (who cannot live normally without caregivers' help)

101x76mm (768 x 768 DPI)



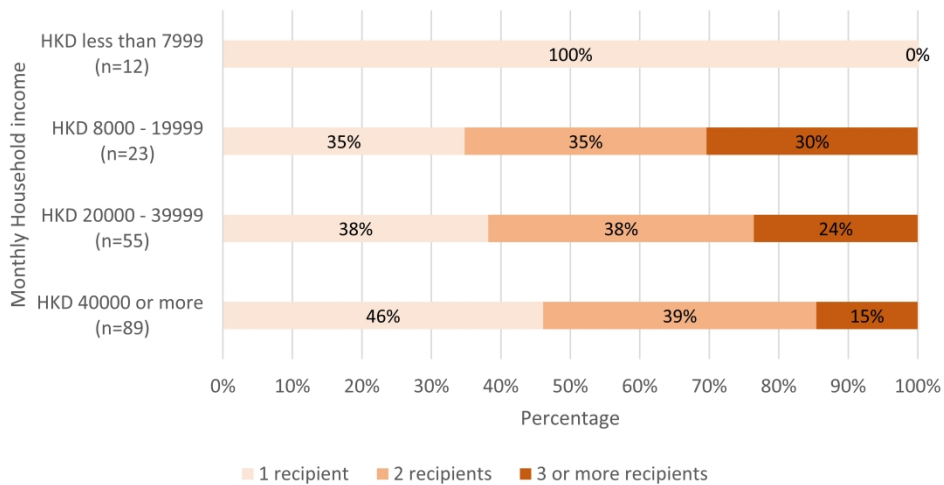


Figure 2. The relationship between household income and informal home care duties

177x88mm (768 x 768 DPI)

**Table of contents**

Page

Table S1. Factors associated with self-perceived increased difficulty in daily living .....2

Table S2. Sociodemographic predictors for care providers who believed to have adequate knowledge for routine care and COVID infection control.....5

For peer review only

Table S1. Factors associated with self-perceived increased difficulty in daily living

	No	Yes	p	AOR (LB-UB)	p
N	120	71			
<b>Socio-demographic</b>					
Age <sup>a</sup>			0.306		
18-44	34.2%	43.7%			
45-64	49.2%	38.0%			
65 or more	16.7%	18.3%			
Gender			0.441		
Male	35.0%	29.6%			
Female	65.0%	70.4%			
Education attainment			0.356		
Primary level or below	10.0%	4.2%			
Secondary level	48.3%	52.1%			
Tertiary level	41.7%	43.7%			
Occupation			0.903		
White collar	44.8%	44.3%			
Blue collar (including services and sales)	19.0%	17.1%			
Housewives	21.6%	25.7%			
Students	0.9%	0.0%			
Unemployed or retired	13.8%	12.9%			
Housing			0.703		
Public housing	25.8%	21.1%			
Subsidized housing	13.3%	9.9%			
Private housing (including independent villa)	60.0%	67.6%			
Others	0.8%	1.4%			
Household income			0.422		
<7999	4.5%	10.6%			
8000 – 19999	14.3%	10.6%			
20000 – 39999	30.4%	30.3%			
40000 or more	50.9%	48.5%			
Housing size			0.397		
Small (350ft or below)	16.2%	22.4%			
Medium (351 ft- 800ft)	67.6%	67.2%			
Large (801 ft. or above)	16.2%	10.4%			
Chronic disease condition			0.616		
No	79.2%	76.1%			
Yes	20.8%	23.9%			
Marital status			0.001		
Unmarried (including divorced or widow)	32.5%	11.3%		Ref.	
Married	67.5%	88.7%		2.81 (0.98 – 8.09)	0.055

Having sufficient knowledge to take care their family members			0.463		
Not sure or No	9.6%	13.0%			
Yes	90.4%	87.0%			
<b>Characteristics of the care recipient</b>					
Number of care recipient			0.797		
1 recipient	47.5%	43.7%			
2 recipients	35.0%	35.2%			
3 or more recipients	17.5%	21.1%			
Family member as fragile elderly or disabilities			0.958		
No	68.6%	69.0%			
Yes (with either one)	31.4%	31.0%			
Children were the care recipients			0.075		
No	42.5%	29.6%		Ref.	
Yes	57.5%	70.4%		0.83 (0.34 – 2.05)	0.688
Spouse was the care recipient			0.148		
No	73.3%	63.4%			
Yes	26.7%	36.6%			
Parents or parents-in-law were the care recipients*			0.033		
No	65.8%	80.3%		Ref.	
Yes	34.2%	19.7%		0.23 (0.08- 0.70)	0.009
Family member who were dependent recipients *			<0.001		
No	49.1%	13.0%		Ref.	
Yes	50.9%	87.0%		6.38 (2.69 – 15.14)	<0.001
Family member received care due to staying at home during COVID-19 outbreak ^			0.053		
No	81.9%	69.6%		Ref.	
Yes	18.1%	30.4%		1.70 (0.70 – 4.13)	0.238
Family member who receive care mainly due to their chronic condition			0.709		
No	88.8%	87.0%			
Yes	11.2%	13.0%			
<b>The effect brought by COVID-19</b>					
Stopped or decrease the use of community services during COVID-19 outbreak+			0.007		
No	95.8%	84.5%		Ref.	

	Yes	4.2%	15.5%		3.22 (0.73 – 14.19)	0.122
	Need to take personal leave for caregiving responsibility*			<0.001		
	No	92.4%	63.4%		Ref.	
	Yes	7.6%	36.6%		7.15 (2.44 – 20.91)	<0.001

+Using Fisher's exact test, ^p<0.10, \* p<0.05,

<sup>a</sup>The age group "18-24" and "25-44" were collapsed

In the multivariable logistic regression, there were 7 missing values in variable *family member who were dependent recipients*, 2 missing values in *stopped or decrease the use of community services during COVID-19 outbreak*, 2 missing values in *need to take personal leave for caregiving responsibility*, 7 missing values in *stay at home during COVID-19 outbreak*, and 1 missing value in *perceived increased difficulty in daily live*

Or peer review only

Table S2. Sociodemographic predictors for care providers who believed to have adequate knowledge for routine care and COVID infection control

	Knowledge for routine care			Knowledge of COVID-19 risk mitigation		
N	20 (10.9%)	164 (89.1%)		95 (49.5%)	97 (50.5%)	
	Not enough knowledge	Enough knowledge	p	Not enough knowledge	Enough knowledge	p
<b>Socio-demographic details</b>						
Age <sup>ab</sup>			0.036*			0.349
18-44	25.0%	39.6%		43.2%	33.0%	
45-64	35.0%	45.1%		41.1%	48.5%	
65 or more	40.0%	15.2%		15.8%	18.6%	
Gender			0.455			0.958
Male	40.0%	31.7%		32.6%	33.0%	
Female	60.0%	68.3%		67.4%	67.0%	
Education attainment			<0.001*			0.160
Primary or below	30.0%	4.3%		10.5%	5.2%	
Secondary	45.0%	49.4%		52.6%	46.4%	
Tertiary	25.0%	46.3%		36.8%	48.5%	
Marital status <sup>a</sup>			0.786			0.453
Non-married	20.0%	25.0%		27.4%	22.7%	
Married	80.0%	75.0%		72.6%	77.3%	
Housing <sup>a</sup>			0.236			0.897
Public housing	40.0%	22.0%		23.2%	25.8%	
Subsidized housing	15.0%	12.2%		13.7%	10.3%	
Private housing (including independent villa)	45.0%	65.2%		62.1%	62.9%	
Others	0.0%	0.6%		1.1%	1.0%	
Living density (household size / number of people) <sup>a</sup>			0.900			0.428
<200 ft per ppl	62.5%	60.9%		65.5%	59.8%	
200 ft or more per ppl	37.5%	39.1%		34.5%	40.2%	
Main information channel <sup>a</sup>			0.653			0.249
Television	50.0%	34.1%		38.9%	34.0%	
Internet or smartphone app	45.0%	57.9%		56.8%	55.7%	

Others (newspaper, radio)	5.0%	7.9%		4.2%	10.3%	
Housing size <sup>a</sup>			0.104			0.547
Small (350ft or below)	31.3%	16.7%		20.7%	16.3%	
Medium (351 ft- 800ft)	68.8%	67.3%		67.8%	67.4%	
Large (801 ft. or above)	0.0%	16.0%		11.5%	16.3%	
Family income group <sup>a</sup>			<0.001*			0.323
<7999	27.8%	4.5%		5.8%	7.5%	
8000 – 19999	11.1%	13.5%		12.8%	12.9%	
20000 – 39999	50.0%	27.6%		37.2%	24.7%	
40000 or more	11.1%	54.5%		44.2%	54.8%	
Employment <sup>a</sup>			0.010*			0.699
White collar	15.0%	49.1%		44.6%	44.2%	
Blue collar (including services and sales)	20.0%	17.6%		18.5%	18.9%	
Students	0.0%	0.0%		25.0%	21.1%	
Housewives	45.0%	20.1%		1.1%	0.0%	
Unemployment and retired	20.0%	13.2%		10.9%	15.8%	
<b>Care recipient characteristics</b>						
Children were the care recipients			0.059			0.528
No	55.0%	33.5%		35.8%	40.2%	
Yes	45.0%	66.5%		64.2%	59.8%	
Spouse was the care recipient			0.723			0.594
No	65.0%	68.9%		71.6%	68.0%	
Yes	35.0%	31.1%		28.4%	32.0%	
Parents or parents-in-law were the care recipients			0.597			0.480
No	65.0%	70.7%		73.7%	69.1%	
Yes	35.0%	29.3%		26.3%	30.9%	
Family members were dependent recipients			0.044*			0.817
No	15.0%	37.8%		34.8%	36.5%	

	Yes	85.0%	62.2%		65.2%	63.5%	
Members were fragile elderly or disabilities				0.040*			0.709
	No	47.4%	70.6%		70.2%	67.7%	
	Yes	52.6%	29.4%		29.8%	32.3%	
<sup>a</sup> Fisher's exact test was performed for analysis about "knowledge for routine care" <sup>b</sup> The age group "18-24" and "25-44" were combined as the age group "18-24" only have 2 subjects * $p < 0.05$							

For peer review only



STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5
		(b) Describe any methods used to examine subgroups and interactions	5
		(c) Explain how missing data were addressed	5
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	5
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5,7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5,7
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	6-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-11

		(b) Report category boundaries when continuous variables were categorized	6-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-13
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).