Samuel Yeung Shan Wong, Dexing Zhang, Regina Wing Shan Sit, Benjamin Hon Kei Yip, Roger Yat-nork Chung, Carmen Ka Man Wong, Dicken Cheong Chun Chan, Wen Sun, Kin On Kwok and Stewart W Mercer

# Impact of COVID-19 on loneliness, mental health, and health service utilisation:

## a prospective cohort study of older adults with multimorbidity in primary care


## Abstract

**Background**
The COVID-19 pandemic has impacted the psychological health and health service utilisation of older adults with multimorbidity, who are particularly vulnerable.

**Aim**
To describe changes in loneliness, mental health problems, and attendance to scheduled medical care before and after the onset of the COVID-19 pandemic.

**Design and setting**
Telephone survey on a pre-existing cohort of older adults with multimorbidity in primary care.

**Method**
Mental health and health service utilisation outcomes were compared with the outcomes before the onset of the COVID-19 outbreak in Hong Kong using paired *t*-tests, Wilcoxon's signed-rank test, and McNemar's test. Loneliness was measured by the De Jong Gierveld Loneliness Scale. The secondary outcomes (anxiety, depression, and insomnia) were measured by the 9-item Patient Health Questionnaire, the 7-item Generalized Anxiety Disorder tool, and the Insomnia Severity Index. Appointments attendance data were extracted from a computerised medical record system. Sociodemographic factors associated with outcome changes were examined by linear regression and generalised estimating equations.

**Results**
Data were collected from 583 older (≥60 years) adults. There were significant increases in loneliness, anxiety, and insomnia, after the onset of the COVID-19 outbreak. Missed medical appointments over a 3-month period increased from 16.5% 1 year ago to 22.0% after the onset of the outbreak. In adjusted analysis, being female, living alone, and having >4 chronic conditions were independently associated with increased loneliness. Females were more likely to have increased anxiety and insomnia.

**Conclusion**
Psychosocial health of older patients with multimorbidity markedly deteriorated and missed medical appointments substantially increased after the COVID-19 outbreak.


**Keywords**
cohort studies; COVID-19; help-seeking behaviour; multimorbidity; psychosocial health; severe acute respiratory syndrome coronavirus 2.

## INTRODUCTION

Since the World Health Organization (WHO) declared Coronavirus Disease 2019 (COVID-19) a pandemic on 11 March 2020, countries across the world have adopted various levels of social distancing measures to limit the spread of the virus. In Hong Kong, the first confirmed COVID-19 case was reported on 23 January 2020. Although evidence suggests that social distancing measures are effective in controlling the spread of the virus,[1] there are likely to be adverse effects on psychological, social, and physical health, especially among vulnerable parts of the population. For example, older adults with chronic conditions and people with low socioeconomic statuses are two of the most vulnerable populations.[2,3] It is well established that social isolation among older adults is an important public health concern owing to the impact it can have on various aspects of mental and physical health.[4] Because the morbidity and mortality of COVID-19 were worse among older adults with chronic conditions, older adults have been advised to stay at home, which will inevitably increase social isolation.[5] In a recent position paper, a group of mental health researchers proposed that studying the secondary psychological impact of COVID-19 should be one of the priorities of research in the pandemic.[6] In Hong Kong, although the government has advised all of its residents to avoid social gatherings and stay at home, primary care outpatient clinics have continued to operate as usual during the COVID-19 outbreak.[7] By using data from an existing primary care cohort of older adults with multiple chronic conditions (multimorbidity),[8] the current study was conducted to describe changes in loneliness, mental health problems (depression, anxiety, and insomnia), and attendance to scheduled chronic disease care before and after the onset of the COVID-19 pandemic. The sociodemographic factors associated with these changes were also examined.

## METHOD

### Study design and setting

The initial cohort consisted of a total of 1077 participants who were recruited from four public primary care clinics in Hong Kong from 7 June 2016 to 23 October 2017; however, only screening questions (rather than full-scale assessments) on anxiety, depression, loneliness, and insomnia were asked.[8] The first face-to-face follow-

**SYS Wong**, MD, MPH, CCFP, FCFPC, FRACGP, FFPH, FHKCCM, FHKAM (Community Medicine), FHKAM (Family Medicine), director; **D Zhang**, BMed, MMed, PhD, research assistant professor; **RWS Sit**, MBBS, DCH, DPD, PDip Community Geriatrics, DipMed, FRACGP, FHKCFP, FHKAM (Family Medicine), associate professor; **BHK Yip**, RBS, MS, PhD, assistant professor; **RY Chung**, BA, MHS, PhD, assistant professor; **CKM Wong**, BSc, MBBCh, DRCOG, MRCGP, MSc Clinical Education, FHEA, associate professor; **DCC Chan**, BSc, MSc, research associate; **W Sun**, BSc, MPH, research assistant, JC School of Public Health and Primary Care, the Chinese University of Hong Kong, Hong Kong SAR, China. **KO Kwok**, BSc, MPhil, PhD, assistant professor, JC School of Public Health and Primary Care, the Chinese University of Hong Kong, Hong Kong SAR; Stanley Ho Centre for Emerging Infectious Diseases, the Chinese University of Hong Kong, Shatin, Hong Kong SAR; Shenzhen Research Institute of the Chinese University of Hong Kong, Shenzhen, China. **SW Mercer**, PhD, FRCGP, professor of primary care research, the Usher Institute, Old Medical School, University of Edinburgh, Edinburgh, UK.

**Address for correspondence**
Samuel Yeung Shan Wong, JC School of Public Health and Primary Care, the Chinese University of Hong Kong, 2/F, Prince of Wales Hospital, Shatin, New Territories, Hong Kong.
**Email:** yeungshanwong@cuhk.edu.hk

**Submitted:** 28 May 2020; **Editor's response:** 1 July 2020; **final acceptance:** 6 August 2020.

## How this fits in

Although evidence suggests that social distancing measures are effective in controlling the spread of the novel coronavirus, there are likely to be adverse effects on psychological, social, and physical health, among one vulnerable population in particular — older adults with multimorbidity. Using pre- and peri-COVID-19 data from a cohort of older patients (≥60 years) with multimorbidity in primary care, this study aimed to understand changes in loneliness, mental health problems, and attendance to scheduled medical care among the cohort. It was found that older patients with multiple chronic conditions had increased loneliness, anxiety, and insomnia. They also had increased missed scheduled appointments for chronic disease care. Being female, living alone, and having >4 chronic conditions were risk factors. Interventions such as teleconsultations are needed for loneliness, mental health, and health service accessibility. The article highlights the importance of continuity of care in general practice, particularly for patients with multimorbidity conditions. The missed appointments observed in the current study can potentially lead to serious complications or adverse events if not addressed, as well as creating additional burden on the already stretched healthcare system considering the current climate of COVID-19. Future research attention is needed to provide alternative strategies for people with multiple chronic conditions.

up assessments ($n$ = 746) that used full-scale assessments on loneliness, anxiety, depression, and insomnia were conducted from 3 April 2018 to 6 March 2019 (hereby defined as pre-COVID-19 assessment in this study). The second follow-ups on full-scale assessments of loneliness, anxiety, depression, and insomnia were conducted over the telephone from 24 March to 15 April 2020 (defined as peri-COVID-19 assessment during the outbreak; $n$ = 677). Because the baseline assessments (from 2016–2017) only included screening questions (published in detail previously),[8] this study only considered the first follow-up (pre-COVID-19) and the second follow-up (peri-COVID-19) assessments in describing the changes in psychosocial outcomes before and during the COVID-19 outbreak in Hong Kong.

### Participants

The eligibility criteria for the initial multimorbidity cohort were described elsewhere.[8] In brief, older adults aged ≥60 years, who had ≥2 chronic conditions, were recruited from four public primary care clinics in Hong Kong. They also had to understand and speak Cantonese to be recruited in this study. For the pre-COVID-19 assessments, patients were assessed face-to-face in one of the four public primary care clinics, which was also a teaching and research clinic affiliated with the university. For the peri-COVID-19 assessments, telephone interviews were conducted with at least three telephone calls at different times on three different days to reach the participants. All assessments were conducted by trained research nurses, social workers, and research assistants. Among the 746 pre-COVID-19 assessment responders, a total of 583 patients completed both the pre- and peri-COVID-19 assessments and were then included in this study. The response rate was 78% ($n$ = 583).

### Primary outcome measure

*Loneliness.* Loneliness was measured using the 6-item De Jong Gierveld Loneliness Scale (DJGLS).[9] The DJGLS is a reliable and valid loneliness scale for Chinese older adults. It has two subscales for social and emotional loneliness and an overall loneliness score. Scores of 0–1, 2–4, and 5–6 in the DJGLS represent no, moderate, and severe loneliness levels respectively.[10]

### Secondary outcome measures

*Depression, anxiety, and insomnia.* Depressive symptoms and general anxiety symptoms were measured using the 9-item Patient Health Questionnaire (PHQ-9)[11,12] and the 7-item Generalized Anxiety Disorder (GAD-7)[13] scale, respectively. Insomnia was measured by the 7-item Chinese version of the Insomnia Severity Index (ISI).[14] All three scales were validated with acceptable psychometric properties among the Chinese population, with higher scores denoting higher levels of depression, anxiety, or insomnia, respectively.[11–16]

*Healthcare utilisation for chronic conditions.* Information on missed scheduled medical appointments was retrieved from the Clinical Management System (CMS) in Hong Kong, which has been previously validated for its accuracy in research.[17] The number of 'no show' appointments were counted over a 3-month period after the first reported COVID-19 cases in Hong Kong (23 January to 22 April 2020) and 1 year ago for the same period

## Table 1. Demographics of participants[a]

| | Responder (*N* = 583) | Non-responder (*N* = 163) | *P*-value |
|---|---|---|---|
| **Age, years, mean (SD)** | 70.9 (6.1) | 70.8 (6.8) | 0.913 |
| **Sex, *n* (%)** | | | 0.020[b] |
| Male | 160 (27.4) | 60 (36.8) | |
| Female | 423 (72.6) | 103 (63.2) | |
| **Education, *n* (%)** | | | 0.221 |
| >6 years | 276 (47.3) | 86 (52.8) | |
| ≤6 years | 307 (52.7) | 77 (47.2) | |
| **Marital status, *n* (%)** | | | 0.567 |
| Married | 386 (66.3)[c] | 112 (68.7) | |
| Single/divorced/separated/widowed | 196 (33.7)[c] | 51 (31.3) | |
| **Living alone, *n* (%)** | | | 0.590 |
| No | 499 (85.7)[c] | 137 (84.0) | |
| Yes | 83 (14.3)[c] | 26 (16.0) | |
| **Working status, *n* (%)** | | | 0.493 |
| Employed | 44 (7.6)[c] | 15 (9.2) | |
| Retired/housewife | 538 (92.4)[c] | 148 (90.8) | |
| **CSSA, *n* (%)** | | | 0.543 |
| No | 515 (88.5)[c] | 147 (90.2) | |
| Yes | 67 (11.5)[c] | 16 (9.8) | |
| **Number of chronic conditions, *n* (%)** | | | 0.926 |
| 2–4 | 384 (65.9) | 108 (66.3) | |
| >4 | 199 (34.1) | 55 (33.7) | |

*[a]Independent-samples* t*-test and* $\chi^2$ *test were used to determine the demographics differences between responders and non-responders of the telephone survey during the COVID-19 outbreak. [b]P-value <0.05. [c]582 responders answered for this item. CSSA = Comprehensive Social Security Assistance.*

(23 January to 22 April 2019). Among the 583 participants, three did not have any appointments scheduled during the COVID-19 outbreak (since January 2020), and the CMS data of 16 patients were not available; therefore, 564 patients' data were retrieved in total.

The sociodemographic information included age, sex, education, marital status, living status, employment, and enrolment in the Comprehensive Social Security Assistance (CSSA) scheme for low-income families in Hong Kong. The number of chronic conditions of patients were collected and categorised into two groups: 2–4 and >4 chronic conditions, in accordance with previous studies.[18–20]

### Statistical methods

Mean, standard deviation, and percentage were used for data description. Independent samples *t*-test and $\chi^2$ tests were used to compare the characteristics of responders and non-responders. Paired *t*-tests for psychological scores, Wilcoxon's signed-rank test for ordinal levels of clinically relevant categories, and McNemar's test for healthcare utilisation (dichotomous variable) were used to compare the differences between pre- and peri-COVID-19 pandemic periods within matched pairs. A univariable analysis was conducted to explore the association between independent variables (sociodemographic data and number of chronic conditions) and dependent outcome measures using linear regression (for DJGLS, GAD-7, PHQ-9, and ISI) with adjustment of pre-COVID values. Multiple linear regression was used to examine the independent association between the independent and dependent variables (DJGLS, GAD-7, PHQ-9, and ISI) by entering all the independent variables, with adjustment of pre-COVID-19 values. Generalised estimating equation (GEE) provides a semi-parametric approach to longitudinal analysis of categorical response. In the univariable GEE, assuming an unstructured covariance structure, time (0 = pre-COVID-19, 1 = peri-COVID-19) within patient as cluster, the independent variable, and the interaction of time with the independent variable were all included. In the multiple regression using the GEE, time, all independent variables, and their respective interactions with time, were included. Furthermore, regression coefficients (β), log odds ratio of interaction terms, and their 95% confidence intervals (CIs) were shown. Statistical significance was considered when *P*-values were <0.05 (two-sided). Statistical analyses were performed using the statistical package IBM SPSS Statistics (version 26).

## RESULTS

The characteristics of the 583 participants are shown in Table 1. Compared with non-responders (*n* = 163), the responders (*n* = 583) of the telephone survey were more likely to be female (72.6% versus 63.2%, *P* = 0.02).

### Primary and secondary outcomes

Table 2 shows that, compared with baseline scores before the COVID-19 outbreak, overall, social, and emotional loneliness were worse since the COVID-19 outbreak (*P*<0.05). For secondary outcomes, both anxiety (*P* = 0.011) and insomnia (*P* = 0.006) levels increased significantly. There was no significant change in depressive symptoms (*P* = 0.359). Compared with results before the COVID-19 onset, a lower proportion of participants were not lonely (29.9% versus 59.5%), and a higher proportion of participants had moderate loneliness (42.4% versus 31.8%) or severe loneliness (27.7% versus 8.8%) during the COVID-19 pandemic. In addition, a lower proportion of participants had very mild anxiety (72.7%

**Table 2. Comparison of outcomes pre- and during the COVID-19 outbreak (*N* = 583)**

| | Pre-COVID-19 | Peri-COVID-19 | | |
|---|---|---|---|---|
| | Mean (CI)/*n* (%) | Mean (CI)/*n* (%) | Paired mean difference (CI) | *P*-value |
| **DJG Loneliness total (0–6)[a,b]** | 1.6 (1.4 to 1.7) | 2.9 (2.7 to 3.1) | 1.35 (1.16 to 1.55) | <0.001[c] |
| Not lonely (0–1) | 346 (59.5)[d] | 174 (29.9)[d] | | <0.001[c] |
| Moderately lonely (2–4) | 185 (31.8)[d] | 247 (42.4)[d] | | |
| Severely lonely (5–6) | 51 (8.8)[d] | 161 (27.7)[d] | | |
| **Social loneliness (0–3)[a]** | 0.8 (0.7 to 0.9) | 1.7 (1.6 to 1.8) | 0.85 (0.72 to 0.98) | <0.001[c] |
| **Emotional loneliness (0–3)[a]** | 0.7 (0.7 to 0.8) | 1.2 (1.1 to 1.3) | 0.50 (0.39 to 0.60) | <0.001[c] |
| **GAD-7 (0–21)[a,b]** | 2.5 (2.2 to 2.8) | 3.0 (2.7 to 3.3) | 0.48 (0.11 to 0.86) | 0.011[c] |
| Very mild (0–4) | 470 (80.6) | 424 (72.7) | | 0.011[c] |
| Mild (5–9) | 78 (13.4) | 122 (20.9) | | |
| Moderate (10–14) | 20 (3.4) | 23 (3.9) | | |
| Severe (15–21) | 15 (2.6) | 14 (2.4) | | |
| **ISI (0–28)[a,b]** | 6.9 (6.5 to 7.3) | 7.5 (7.1 to 7.9) | 0.66 (0.19 to 1.13) | 0.006[c] |
| No clinically significant insomnia (0–7) | 351 (60.2) | 318 (54.6)[d] | | <0.001[c] |
| Sub-threshold insomnia (8–14) | 169 (29.0) | 195 (33.5)[d] | | |
| Moderate/severe insomnia (15–28) | 63 (10.8) | 69 (11.9)[d] | | |
| **PHQ-9 (0–27)[a,b]** | 4.4 (4.0 to 4.7) | 4.5 (4.2 to 4.9) | 0.19 (–0.21 to 0.59) | 0.359 |
| Normal (0–4) | 364 (62.4) | 351 (60.2) | | 0.358 |
| Mild (5–9) | 153 (26.2) | 164 (28.1) | | |
| Moderate (10–14) | 50 (8.6) | 42 (7.2) | | |
| Moderately severe/severe (15–27) | 16 (2.7) | 26 (4.5) | | |
| **Missed medical appointment[c,e]** | 93 (16.5) | 124 (22.0) | | 0.014[f] |

*[a]Paired t-test was used to compare the mean differences of psychological outcomes. [b]Wilcoxon's signed-rank test was used to test the difference of clinically relevant categories. [c]McNemar's test was used to determine the difference in the proportion of subjects' missed medical appointments. [d]582 responders answered for this item. [e]564 patients' data were received for this item. [f]P-value <0.05. DJG = De Jong Gierveld. GAD-7 = 7-item Generalized Anxiety Disorder. ISI = Insomnia Severity Index. PHQ-9 = 9-item Patient Health Questionnaire.*

versus 80.6%) and a higher proportion of participants had mild anxiety (20.9% versus 13.4%) during the COVID-19 pandemic; however, the proportion of moderate and severe anxiety remained almost the same (6.3% versus 6.0%) before and after the onset of COVID-19. Furthermore, a lower proportion of participants had no clinically significant insomnia (54.6% versus 60.2%), and a higher proportion of participants had subthreshold insomnia (33.5% versus 29.0%) and moderate/severe insomnia (11.9% versus 10.8%) during the COVID-19 pandemic.

Tables 3 and 4 show the univariable and multiple regression results, respectively. In the full multiple regression model, those who lived alone (β = 0.43, CI = 0.06 to 0.80), were female (β = 0.26, CI = 0.01 to 0.53), and had >4 chronic conditions (β = 0.23, CI = 0.01 to 0.46) were more likely to have increased social loneliness. Moreover, those who lived alone were also more likely to have increased overall loneliness (β = 0.64, CI = 0.09 to 1.19). Females were also more likely to have increased anxiety (β = 0.86, CI = 0.11 to 1.61) and insomnia (β = 1.40, CI = 0.44 to 2.35). CSSA recipients were less likely to have increased insomnia compared with non-CSSA recipients (β = –1.89, CI = -3.16 to –0.61).

There were 16.5% and 22.0% of the participants who missed their scheduled medical appointments for chronic disease care over a period of 3 months 1 year ago and after the onset of the outbreak, respectively (*P* = 0.014) (Table 2). There was no significant association for any sociodemographic factors in relative change of missed medical appointments after adjustment (Table 4).

## DISCUSSION

### Summary

There is likely to be an increase in mental health problems as a repercussion of the current pandemic and its intervention strategies for infection control. This may be particularly important for older adults with multimorbidity. This study shows that older patients with multimorbidity in primary care experienced worse psychosocial health and an increase in missed scheduled medical appointments for chronic disease care after the onset of the COVID-19 outbreak. Being female, living alone, and having more chronic conditions were associated with a higher risk for worse outcomes.

This study found that older adults who lived alone were more likely to have social loneliness during COVID-19. This was probably because they relied more on family members and friends who were not living together for social support, and such support was reduced because of social distancing during COVID-19.

### Strengths and limitations

To the best of the authors' knowledge, this is the first study on the impact of the COVID-19 outbreak on loneliness and other mental health and health service use outcomes among older patients with multimorbidity in primary care, using pre- and peri-COVID-19 data of a cohort.

There were several limitations. First, it was only possible to conduct assessments before and during the COVID-19 outbreak; therefore, other potential confounding effects on outcomes not attributed to the impact of COVID-19 could not be excluded, including the natural history of deteriorating mental health over time and the effects of other unmeasured confounders during this period. Another related potential

## Table 3. Univariable regression of demographic factors and outcomes during the COVID-19 outbreak

| Variable | DJG Loneliness total[a] | Social loneliness[a] | Emotional loneliness[a] | GAD-7[a] | ISI[a] | PHQ-9[a] | Missed appointment[b] |
|---|---|---|---|---|---|---|---|
| Age, years | 0.01 (–0.02, 0.03) | 0.01 (–0.01, 0.02) | –0.01 (–0.02, 0.01) | –0.03 (–0.08, 0.02) | 0.01 (–0.06, 0.06) | –0.02 (–0.08, 0.04) | 0.05 (0.01, 0.10)[c] |
| Female | 0.29 (–0.07, 0.64) | 0.24 (–0.01, 0.48) | 0.05 (–0.15, 0.24) | 0.99 (0.30, 1.68)[c] | 1.23 (0.36, 2.10)[c] | 0.56 (–0.22, 1.33) | –0.02 (–0.60, 0.56) |
| Education ≤6 years | 0.04 (–0.28, 0.35) | 0.04 (–0.18, 0.26) | –0.01 (–0.19, 0.16) | 0.50 (–0.11, 1.12) | 0.09 (–0.68, 0.86) | 0.36 (–0.33, 1.04) | 0.43 (–0.12, 0.99) |
| Single/divorced/ separated/widowed[d] | 0.45 (0.11, 0.78)[c] | 0.30 (0.08, 0.53)[c] | 0.15 (–0.04, 0.33) | 0.26 (–0.38, 0.90) | 0.05 (–0.77, 0.86) | –0.26 (–0.99, 0.46) | 0.75 (0.17, 1.32)[c] |
| Living alone | 0.79 (0.34, 1.24)[c] | 0.54 (0.23, 0.84)[c] | 0.26 (0.01, 0.50)[c] | 0.70 (–0.16, 1.56) | 0.01 (–1.09, 1.11) | –0.40 (–1.38, 0.58) | 0.53 (–0.17, 1.23) |
| Retired/housewife[e] | –0.08 (–0.69, 0.52) | –0.18 (–0.59, 0.23) | 0.10 (–0.23, 0.43) | 0.56 (–0.59, 1.71) | 0.55 (–0.91, 2.01) | 0.93 (–0.36, 2.23) | 0.39 (–0.61, 1.39) |
| CSSA | 0.33 (–0.17, 0.84) | 0.22 (–0.12, 0.57) | 0.10 (–0.18, 0.37) | 0.46 (–0.49, 1.41) | –1.61 (–2.81, –0.41)[c] | –0.80 (–1.89, 0.29) | 0.43 (–0.41, 1.28) |
| Chronic conditions >4[f] | 0.22 (–0.11, 0.56) | 0.25 (0.19, 0.47)[c] | –0.01 (–0.20, 0.17) | 0.38 (–0.27, 1.03) | 0.42 (–0.40, 1.24) | 0.23 (–0.50, 0.97) | 0.53 (–0.04, 1.09) |

*[a]Linear regression was used to explore the association between independent variables and outcome scores during the COVID-19 outbreak with adjustment of pre-COVID-19 scores; regression coefficients (95% CIs) were presented. [b]Generalised estimating equation was used to study the association between independent variables and change of missed appointments during the COVID-19 outbreak; log odds ratio of interaction terms (independent variable*time) were presented with 95% CIs. [c]P-value <0.05. [d]Reference group for marital status = married. [e]Reference group for working status = employed. [f]Reference group for number of chronic conditions = 2–4 chronic conditions. CSSA = Comprehensive Social Security Assistance. DJG = De Jong Gierveld. GAD-7 = 7-item Generalized Anxiety Disorder. ISI = Insomnia Severity Index. PHQ-9 = 9-item Patient Health Questionnaire.*

## Table 4. Multiple regression of demographic factors and outcomes during the COVID-19 outbreak

| Variable | DJG Loneliness total[a] | Social loneliness[a] | Emotional loneliness[a] | GAD-7[a] | ISI[a] | PHQ-9[a] | Missed appointment[b] |
|---|---|---|---|---|---|---|---|
| Age, years | 0.01 (–0.03, 0.03) | 0.01 (–0.13, 0.30) | –0.01 (–0.02, 0.01) | –0.03 (–0.08, 0.02) | 0.02 (–0.05, 0.09) | –0.02 (–0.08, 0.04) | 0.03 (–0.02, 0.08) |
| Female | 0.26 (–0.13, 0.65) | 0.26 (0.01, 0.53)[c] | –0.01 (–0.23, 0.20) | 0.86 (0.11, 1.61)[c] | 1.40 (0.44, 2.35)[c] | 0.45 (–0.40, 1.30) | –0.18 (–0.83, 0.48) |
| Education ≤6 years | –0.05 (–0.39, 0.28) | –0.02 (–0.25, 0.20) | –0.03 (–0.22, 0.15) | 0.38 (–0.25, 1.02) | 0.07 (–0.73, 0.87) | 0.39 (–0.33, 1.11) | 0.26 (–0.31, 0.82) |
| Single/divorced/ separated/widowed[d] | 0.12 (–0.31, 0.54) | 0.04 (–0.25, 0.33) | 0.09 (–0.15, 0.32) | –0.31 (–1.12, 0.50) | –0.34 (–1.37, 0.68) | –0.30 (–1.22, 0.62) | 0.64 (–0.15, 1.43) |
| Living alone | 0.64 (0.09, 1.19)[c] | 0.43 (0.06, 0.80)[c] | 0.21 (–0.10, 0.51) | 0.80 (–0.25, 1.85) | 0.54 (–0.79, 1.87) | 0.01 (–1.19, 1.20) | –0.04 (–0.99, 0.91) |
| Retired/housewife[e] | –0.19 (–0.83, 0.44) | –0.33 (–0.75, 0.10) | 0.14 (–0.21, 0.49) | 0.33 (–0.88, 1.53) | 0.08 (–1.45, 1.61) | 0.82 (–0.55, 2.19) | 0.07 (–1.02, 1.17) |
| CSSA | 0.06 (–0.48, 0.59) | 0.03 (–0.33, 0.39) | 0.02 (–0.28, 0.31) | 0.15 (–0.86, 1.16) | –1.89 (–3.16, –0.61)[c] | –0.86 (–2.01, 0.30) | 0.06 (–0.82, 0.93) |
| Chronic conditions >4[f] | 0.18 (–0.16, 0.52) | 0.23 (0.01, 0.46)[c] | –0.04 (–0.23, 0.15) | 0.33 (–0.32, 0.98) | 0.63 (–0.20, 1.46) | 0.28 (–0.46, 1.03) | 0.41 (–0.17, 0.99) |

*[a]Linear regression was used to explore the association between independent variables and outcome scores during the COVID-19 outbreak with adjustment of pre-COVID-19 scores. All covariates were mutually adjusted. Regression coefficients (95% CIs) were presented. [b]Generalised estimating equation was used to study the association between independent variables and change of missed appointments during the COVID-19 outbreak. All covariates were mutually adjusted. Log odds ratio of interaction terms (independent variable* time) were presented with 95% CIs. [c]P-value <0.05. [d]Reference group for marital status = married. [e]Reference group for working status = employed. [f]Reference group for number of chronic conditions = 2–4 chronic conditions. CSSA = Comprehensive Social Security Assistance. DJG = De Jong Gierveld. GAD-7 = 7-item Generalized Anxiety Disorder. ISI = Insomnia Severity Index. PHQ-9 = 9-item Patient Health Questionnaire.*

limitation is the length of period difference between pre-COVID-19 assessments (around 12 months) and peri-COVID-19 assessments (around 3 weeks), thus the data of peri-COVID-19 assessments might have been confounded by seasonal factors. Second, the pre-COVID-19 assessments were conducted through face-to-face visits while the assessments during the COVID-19 pandemic were conducted using telephone interviews; as a result, outcomes may have been affected by different data collection methods. However, with the use of validated instruments the impact of the two different measurement methods should be minimal.[21,22] Third, as this study only included patients with complete data before and during the COVID-19 pandemic, when compared to previous studies in Hong Kong, it is likely that more females and younger patients were included,[23,24] and the results may therefore not represent all older patients with multimorbidity in primary care. On the other hand, it is postulated

that the real situation could be worse than that of these findings, because, in general, people who do not respond are likely to suffer from more severe conditions.[25]

**Comparison with existing literature**

Although many agree that mental health problems are an important health issue both during and after the COVID-19 pandemic, it has received relatively less attention compared with the resources and attention that have been devoted to controlling and containing the pandemic.[6,26] In the case of Hong Kong, the government has implemented various social distancing measures for the entire population, including facility closures and restrictions of group gatherings.[27] Other countries such as the UK have adopted a 'shielding' policy, recommending that the most vulnerable groups and older adults aged ≥70 years stay at home for an extended period of time.[5,7] With the current social distancing measures in place, social isolation and loneliness have become an important public health concern, especially among older adults globally.[2,28]

Though only about 15% lived alone, social loneliness was still high among all the study participants. This might be because social loneliness is not related to living status (alone versus not alone) as suggested by a previous study.[29] Instead, poor family functioning and poor social support may be more related to social loneliness. In a recent review, a person's family was found to be the most important source of social support, followed by friends, for Chinese older adults.[30] Indeed, because of the density of the Hong Kong population, people or family members may need to live together in small flats, but there may still be a lack of support to the older adults due to long working hours for the working population. Therefore, people who are living with families or others including domestic helpers can still feel they cannot rely on or trust their co-habitants and feel lonely.

Although people may not relate loneliness with a significant health impact, research shows that loneliness and social isolation are risk factors for increased mortality, with detrimental health effects stronger than that of obesity.[31] In regards to the impact on mental health, Santini and colleagues[32] showed that social disconnectedness and perceived isolation are associated with an increased risk of anxiety and depression among older adults. Loneliness and social isolation are also risk factors for incident coronary heart disease (CHD), stroke,[33] and declined cognition.[34] If the current social distancing measures are to continue, it is likely that an increase in both mental and physical morbidity and mortality will be observed.

A recent review reported that insomnia and anxiety are commonly identified in primary care settings following disasters.[35] Furthermore, evidence from recent epidemics showed that isolation and quarantine were associated with increased depression and anxiety.[36–38] In the current study, however, an increase was found only in anxiety, and not in depression. Anxiety can arise from fear and worry about being infected, and social distancing measures can result in changes to daily routines and disruption of social support. These exacerbate anxiety and cause insomnia. Unreliable and conflicting media exposure can also be a source of constant anxiety, especially in the age of infodemics.[39] The finding that females were more likely to experience insomnia and anxiety is consistent with findings of other recent studies that showed that females experienced higher psychological distress than males early in the COVID-19 outbreak in mainland China.[40,41] Previous research suggests that there was a higher prevalence of social and health worry among females, which may be related to sex differences in health beliefs.[23] On the other hand, recent research on the sex differences in patients with COVID-19 suggests that males may be at higher risk of dying and severe outcomes from COVID-19 when compared with females, independent of age and susceptibility.[42]

To date, to the authors' knowledge, no research has reported changes in health service use among people with chronic conditions before and during the COVID-19 pandemic.[24] In Hong Kong, both public primary care and specialist clinics continue to serve patients during the COVID-19 pandemic, as opposed to the lockdown policy of countries such as the UK.[5] Only elective surgery was cancelled in Hong Kong. It was found that there was still a significant increase in the number of missed scheduled medical appointments among this population — present findings showed that one in five older primary care patients with multimorbidity missed their medical appointments. However, it should be noted that there was non-attendance even before the onset of the COVID-19 outbreak and, therefore, many other factors were also related to non-attendance. A previous study in Hong Kong found that non-attendance in public specialist outpatient clinics were significantly related to doctor shopping and

waiting time.[43] Another study found that the most common reason for missing follow-up appointments in general ophthalmic outpatient clinics in Hong Kong included forgetfulness, being busy, and being unwell on the appointed day.[44] In yet another recent study examining non-attendance in primary care chronic disease management clinics,[45] it was found that health literacy, family, and financial constraints were also factors related to non-attendance for outpatient appointments in Hong Kong. As continuity of care is particularly important for patients with multimorbidity, the missed appointments observed in the current study can potentially lead to serious complications or adverse events, and they can produce an additional burden on the already stretched healthcare system if the issues are not addressed. Therefore, attention is needed to provide alternative strategies for patients with multiple chronic conditions, such as teleconsultations.[41]

### Implications for research and practice

Public health strategies for mental health problems are needed. Interventions such as teleconsultations can be explored and evaluated to provide the required evidence for providing effective telepsychological interventions during a pandemic, with particular attention given to older patients who are female, living alone, having lower income, and having more chronic conditions. There may be a need to further examine and address issues in this population.

Regarding access to smartphone or computer and digital literacy, according to a recent population survey in Hong Kong, about 80% and 90% of people aged ≥10 years have access to a personal computer and a smartphone, respectively.[46] The baseline assessment in the present cohort showed that 52.6% of these older adults had access to smartphones and 51.0% of these older adults used social media platforms such as WhatsApp for communication with family members and friends.[8] The rate of smartphone usage was significantly increased to 67%, with the use of social media platforms increased to 66% after interactive sessions with a social worker was provided to these older adults. A recent telephone survey study conducted by a local non-govern\mental organisation in Hong Kong has found that among 552 community older adult responders, 63% had a smartphone, 60% had used the social media platform WhatsApp, 57% had internet access at home, 89% were willing to receive WhatsApp messages for care, and 51% were willing to receive health-related informational videos (Hong Kong Young Women's Christian Association, unpublished data, 2020). Therefore, there is room for engaging older adults in using telemedicine for their chronic disease care.


### Funding

The staff working on this cohort received funding from the Hong Kong Jockey Club Charities Trust.

### Ethical approval

Ethics approval was obtained from the Joint Chinese University of Hong Kong — New Territories East Cluster Clinical Research Ethics Committee (the Joint CUHK-NTEC CREC) (CREC reference number: 2016.204).

### Provenance

Freely submitted; externally peer reviewed.

### Competing interests

The authors have declared no competing interests.

### Acknowledgements

The authors would like to thank Jennifer Tiu, Lucia Tam, Kala Tsoi, Rym Lee, Tony Leung, Maggie Leung, Zijun Xu, Violet Xu, Ryan Ho, and Lawrence Luk for their assistance in data collection. The authors also greatly thank all the patients who participated in the cohort.




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