COVID-19 related health inequality exists even in a city where disease incidence is relatively low: a telephone survey in Hong Kong

Roger Yat-Nork Chung ,[1,2] Gary Ka-Ki Chung ,[2] Michael Marmot,[2,3] Jessica Allen,[3] Dicken Chan,[1] Peter Goldblatt,[3] Hung Wong,[2,4] Eric Lai,[5] Jean Woo,[2,5] Eng-Kiong Yeoh,[1,2] Samuel Y S Wong[1,2]

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/jech-2020-215392).

[1]School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, Hong Kong
[2]CUHK Institute of Health Equity, The Chinese University of Hong Kong, Hong Kong, Hong Kong
[3]UCL Institute of Health Equity, Research Department of Epidemiology and Public Health, University College London, London, UK
[4]Department of Social Work, The Chinese University of Hong Kong, Hong Kong, Hong Kong
[5]CUHK Institute of Ageing, The Chinese University of Hong Kong, Hong Kong, Hong Kong

Correspondence to
Dr Roger Yat-Nork Chung, School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong 26451, Hong Kong; rychung@cuhk.edu.hk

Received 20 August 2020
Revised 18 November 2020
Accepted 16 December 2020

To cite: Chung RY-N, Chung GK-K, Marmot M, *et al*. *J Epidemiol Community Health* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/jech-2020-215392

ABSTRACT

Background We examined whether COVID-19 could exert inequalities in socioeconomic conditions and health in Hong Kong, where there has been a relatively low COVID-19 incidence.

Methods 752 adult respondents from a previous random sample participated in a telephone survey from 20 April to 11 May 2020. We examined demographic and socioeconomic factors, worry of COVID-19, general health, economic activity, and personal protective equipment (PPE) and related hygiene practice by deprivation status. The associations between deprivation and negative COVID-19 related issues were analysed using binary logistic regressions, while the associations of these issues with health were analysed using linear regressions. Path analysis was conducted to determine the direct effect of deprivation, and the indirect effects via COVID-19 related issues, on health. Interactions between deprivation and the mediators were also tested.

Results Deprived individuals were more likely to have job loss/instability, less reserves, less utilisation and more concerns of PPE. After adjustments for potential confounders, being deprived was associated with having greater risk of low reserve of face masks, being worried about the disease and job loss/instability. Being deprived had worse physical (β=−0.154, p<0.001) and mental health (β=−0.211, p<0.001) and had an indirect effect on mental health via worry and job loss/instability (total indirect effect: β=−0.027, p=0.017; proportion being mediated=11.46%). In addition, significant interaction between deprivation and change of economic activity status was observed on mental health-related quality of life.

Conclusion Even if the COVID-19 incidence was relatively low, part of the observed health inequality can be explained by people's concerns over livelihood and economic activity, which were affected by the containment measures. We should look beyond the incidence to address COVID-19 related health inequalities.

INTRODUCTION

The COVID-19 pandemic continues to be rampant, resulting in more than 53 million cases and 1.3 million deaths worldwide as of mid-November 2020.[1] With the tremendous disease burden, a growing body of evidence suggested that the COVID-19 pandemic exposes and exacerbates inequalities in health.[2 3] In countries with severe COVID-19 outbreaks, a higher rate of incidence or deaths has been widely observed in socially vulnerable groups including people of lower socioeconomic position[4 5] and communities of colour.[6–8] Specifically, the Office for National Statistics in the UK reported a higher COVID-19 mortality rate among low-skilled frontline workers who tend to have lower income and opportunity to work from home.[9] Similar elevated mortality risk also applies to people of black ethnicity, with about half of the inequality across ethnic groups attributable to their differences in socioeconomic circumstances.[10] While the social inequality in terms of COVID-19 incidence or mortality rates may be less apparent in regions with fewer confirmed cases, the question is whether there are really no social inequalities in health related to COVID-19 in these regions.

In addition to the direct disease burden, the COVID-19 outbreak and its associated containment measures such as economic lockdown, mandatory social distancing and change of work arrangements may also have unequal wider socioeconomic impacts on the general population,[2] especially in regions with pervasive existing social inequalities. Given the limited resources and capacity of the socioeconomically disadvantaged to respond to emergency and adverse events,[11] it is argued that their general health and well-being are likely to be disproportionately affected by the abrupt changes in their daily economic and social conditions (eg, job insecurity and anxiety) brought about by the COVID-19 outbreak. As such, focusing only on COVID-19 incidence or mortality as the outcomes of concern to address health inequalities may leave out important aspects of life that contributes significantly to people's health.

Hong Kong, a densely populated city located in Southern China with around 7.5 million people,[12] can serve as an exemplary setting to address the above question given its extreme wealth inequality with an all-time high Gini coefficient of 0.539 in 2016,[13] a relatively low incidence of COVID-19 compared with other world regions being hard hit by the pandemic and its stringent containment measures that impacted on the whole population and economic activity.[14] Before the resurgence of local cases since early July, local spread of COVID-19 was sporadic, and most cases were imported.[14] Starting from late January, cases were

primarily imported by visitors from Wuhan, China, and then by travellers and return students studying overseas,[15] leading to a minor surge between mid-March and mid-April of 874 new cases (cumulative cases rose from 143 on 15 March to 1017 on 15 April). Afterwards, the epidemic maintained at a low level until late June with less than 200 new confirmed cases (cumulative cases rose from 1017 on 15 April to 1206 on 30 June).[14] Most of the imported cases during spring tended to be more well-off. With limited spread from imported cases to the local community by early July, the COVID-19 disease burden appears to be clustered in the higher socioeconomic group.[16] Therefore, the expected social gradient in health impact did not seem to exist in Hong Kong when we focus only on COVID-19-specific incidence. Nonetheless, as mentioned above, the outbreak could have exerted wider impact on social determinants of health that in turn lead to health inequalities more generally. In light of this, the present study aimed to examine whether COVID-19 could contribute to any inequalities in socioeconomic conditions and health in Hong Kong, where there has been a relatively low COVID-19 incidence.

METHODS

Subjects and methods

Respondents were from a previous study entitled '*Trends and Implications of Poverty and Social Disadvantages in Hong Kong: A Multi-disciplinary and Longitudinal Study*', which initially consisted of 2282 household respondents aged 18 years or above from a random sample of all households in Hong Kong. Detailed procedures had been described previously.[17–21] Of these respondents, 1855 in 2014 agreed to provide their contact numbers for participation in future research. Telephone survey was carried out from 20 April to 11 May 2020, during which the average daily number of incident case was 1.09.[14] Interviews were carried out by experienced interviewers between 10:00 and 20:00 on weekdays. Prior appointments were arranged for suitable respondents in other periods including weekends and public holidays. Among the 1855 dialled telephone numbers, 522 were unanswered and 239 were invalid; and among the answered calls, 332 refused to join, 8 were excluded due to health problem and 2 passed away, resulting in a final sample of 752.

Measurements

Information on demographic factors, socioeconomic factors (ie, educational level, social security status, income poverty and deprivation), economic activity, personal protective equipment (PPE) and related personal hygiene practice, as well as impact on well-being and health during the COVID-19 outbreak in Hong Kong were collected, with details below.

Demographic factors

Information on age, sex, marital status, number of people within the household, household composition and place of birth were collected. Particularly, for household composition, we asked about whether the household had younger persons aged 16 years or under who were legally not allowed to be home alone, adults with chronic disease or disability and/or older persons aged 65 years or above. These categories of household members are likely to be associated with greater caregiving burden.

Socioeconomic factors

Information on educational level, social security status, income poverty and deprivation were collected. Anyone receiving the means-tested Comprehensive Social Security Assistance would be regarded as a recipient of social security. Income poverty was measured by equivalised household income by dividing household income by the square root of household size. This allows for economies of scale when comparing different sized households.[22] Respondents were asked to estimate their total pretax monthly household income including social security benefits. People whose equivalised monthly household incomes fell below half of the sample's median (HK$5250) were classified as 'income poor', whereas those above were classified as 'non-income poor'.

In addition, we collected information regarding relative deprivation, which had been consistently shown to have stronger association with health outcomes than income poverty in Hong Kong.[17 19] Following Townsend's theory of relative deprivation, which has been defined as a lack of command over resources covering material and social necessities,[23] a 21-item Deprivation Index (DI) was adopted to assess whether respondents could (not) afford a range of items that were considered to be necessities by the majority of adults in Hong Kong. In our previous research, 301 respondents were randomly selected to answer which items they considered as necessities, and 21 items that were perceived by 50% or more of the respondents as necessities were included in the construction of DI.[17] Four of these items were measures of social deprivation, while the remaining 17 items were measures of material deprivation including food deprivation, clothing deprivation, medical care deprivation, household facilities and equipment, repair and maintenance, and finance. We followed the convention set by Mack and Lansley[24] and considered only those lacking an item due to affordability, rather than to personal preference, to be deprived of that particular item. The DI showed a high reliability with Cronbach alpha at 0.832. Through comparison of weighted mean DI score across deciles of equivalised household income, a DI score of 2 or above was considered 'deprived'. Further details on the construction, validity and reliability of the DI had been described previously.[17]

Economic activity

Information on general economic activity status and change of status after the COVID-19 outbreak were collected. Particularly for those under employment, including the full-time and part-time employees and self-employed, information on their general economic activity (including salary mode, having paid annual/sick leave or not and place of work), as well as changes of their activity after the outbreak (including number of days working outside and from home, change of income, whether being forced to take unpaid leave and their perceived impact on livelihood if they stopped going out to work) were collected.

PPE and personal hygiene practice

Information on availability of PPE commonly regarded as essential in disease prevention (ie, face mask and hand sanitiser) and the corresponding behavioural practice were collected. In particular, these include current mask reserves in the household, difficulty in buying masks, worry about supply and days of wearing mask and using hand sanitiser in the past week.

Impact on well-being and health

We asked how much they worried about the COVID-19 in general using Likert scale. In addition, physical and mental health-related quality of life (HRQOL) was assessed using the 12-item Short-Form Health Survey version 2 (SF-12 V.2), which had been validated for the Hong Kong Chinese population.[25] The instrument could derive two distinct continuous summary

scores, physical component summary (PCS) for physical health and mental component summary (MCS) for mental health. We applied a norm-based scoring algorithm with reference to the data from a Hong Kong general population survey.[26]

Statistical methods

Compared with the Hong Kong general population, our respondents were older and more likely to be female. To ensure the representativeness of our sample, proportional weighting was adopted to reduce the discrepancies of surveyed adults and the general population with respect to age and sex at midyear of 2019. Reference data were obtained from the government's Census and Statistics Department. Data were weighted prior to performing any analysis. We outlined the operational details of the proportional weighting method in online supplemental file 1.

Mean and their corresponding SD were presented for continuous variables, while count with their corresponding percentage was presented for categorical variables. CIs were provided wherever appropriate. Descriptive statistics on demographic factors, socioeconomic factors, worry of COVID-19, general physical and mental HRQOL, economic activity, and PPE and hygiene practice were presented by deprivation status. Independent two-sample t-tests for continuous variables and χ^2 tests for categorical variables were used to test difference between those deprived and non-deprived.

Associations between deprivation and three potential negative COVID-19 related issues (ie, low reserve of face masks in the household, worry of COVID-19 and change of economic activity) were analysed using univariate and multivariable binary logistic regression. Associations of the three negative COVID-19 related issues with physical and mental HRQOL were also analysed using univariate and multivariable linear regression to determine which of the negative COVID-19 related issues might be potential mediator of the association between deprivation and health outcomes. Interactions between deprivation and the potential mediator(s) on HRQOL were also tested. Path analysis in multivariable linear regression using the counterfactual framework was then carried out to determine the direct effect of deprivation and the indirect effects of deprivation via negative COVID-19 related issues on HRQOL. All the models above were adjusted for potential confounders, which were included in the model according to the literature or if they were associated with both deprivation and the outcomes. The same list of confounders was applied for all models for consistency. SPSS V.26 and SAS V.9.4 were employed for statistical analyses. All statistical tests were two tailed with a significant level of 0.05.

RESULTS

Table 1 presents the demographic and socioeconomic characteristics, and health of respondents by deprivation status. All figures presented were based on the weighted sample (original and weighted characteristics of the respondents are compared in online supplemental file 2). A percentage of 21.3 were deprived. Those being deprived were more likely to be older, non-married, having children in the household, less educated, receiving social security, non-locally born and income poor. They were also more likely to be worried about COVID-19 and less healthy both physically and mentally. The income and education distributions of our age-weighted and sex-weighted sample are comparable with the distributions in the latest census of 2016 (data not shown).

Table 2 shows the descriptive statistics on economic activity by deprivation status. The deprived were significantly less prone to be employed, to be paid monthly, to have paid annual or sick leave and working in a district other than their residential district. Regarding COVID-19 related changes in terms of economic activity, there were significantly much higher chance for the deprived of having job loss/instability (ie, being unemployed/having insufficient working hours/having uncertain working hours), having reduced day of working outside, having reduced income and perceiving an impact on their livelihood if they stopped going outside to work. Specifically, up to 17.7% in total had job loss/instability, while the percentage was significantly higher among the deprived (32.3%) than the non-deprived (13.8%). This is echoed by the observation that over half (52.2%) of the deprived worked outside for fewer number of days versus 34.5% of the non-deprived. Moreover, 33.3% in total had income decrease after the outbreak, but the percentage was much higher among the deprived (55.1%) than the non-deprived (28.9%).

Table 2 also shows descriptive statistics on PPE and related hygiene practice by deprivation status. The deprived were less likely to have 1 month or more reserves of face masks in their household, more likely to have difficulty in buying masks and to be worried about the supply, and wear masks less frequently. Specifically, up to 18.2% of the deprived had less than 3 weeks or less reserves of face masks in their household versus 7.8% of the non-deprived. They were also more worried about the supply of hand sanitiser and used it less frequently.

Crude and adjusted ORs, with their corresponding 95% CIs, of the associations between deprivation and the three potential negative COVID-19 related issues are presented in table 3. Univariate associations of demographic, socioeconomic characteristics and current economic activity status by HRQOL and negative COVID-19 related issues are presented in online supplemental file 3. Those who were older, separated/divorced/widowed, income poor, less educated, unemployed/retired and having family member with chronic illness or disabilities were more likely to have lower PCS and MCS scores. Even after adjusting for potential confounders, being deprived remained strongly associated with having low reserve of face masks in the household (OR=2.23, 95% CI 1.21 to 4.10), being worried about COVID-19 (OR=4.07, 95% CI 2.55 to 6.49) and having greater risk of job loss/instability (OR=2.62, 95% CI 1.41 to 4.88).

Table 4 presents the crude and adjusted beta coefficients, with their corresponding 95% CI, of the associations of the three negative COVID-19 related issues with physical and mental HRQOL, and we found that being worried about COVID-19 (β=−2.18, 95% CI −3.54 to −0.82) and job loss/instability (β=−3.61, 95% CI −5.72 to −1.49) were significantly associated with worse MCS, after adjustments. Therefore, these two variables were treated as potential mediators of the association between deprivation and health in the path analysis. In addition, significant interaction (deprivation*change of economic activity status=−6.78 (95% CI −10.41 to –3.14), p<0.001) was observed in association between deprivation and mental HRQOL after adjusting for potential confounders.

As presented in figure 1, results of path analysis showed that being deprived was negatively associated with PCS (β=−0.154, p<0.001) and MCS (β=−0.211, p<0.001), while being worried about COVID-19 (PCS: β=−0.012, p=0.743; MCS: β=−0.057, p=0.121) and job loss/instability (PCS: β=−0.009, p=0.814; MCS: β=−0.111, p=0.002) were negatively associated with PCS and MCS. In addition, being deprived had a significant indirect effect on MCS with being worried about COVID-19 and job loss/instability as the mediating variables

Table 1 Demographic and socioeconomic characteristics, and health by deprivation status

	Total (N (%))	Non-deprived (n (%))	Deprived (n (%))	P value
Age (year)				0.002
18–30	133 (17.7)	115 (19.4)	18 (11.3)	
31–40	136 (18.1)	117 (19.8)	19 (11.9)	
41–50	133 (17.7)	94 (15.9)	39 (24.4)	
51–60	143 (19.0)	116 (19.6)	27 (16.9)	
61–70	112 (14.9)	80 (13.5)	32 (20.0)	
71–80	54 (7.1)	42 (7.1)	12 (7.5)	
81 or above	40 (5.3)	27 (4.6)	13 (8.1)	
Sex				0.089
Male	336 (44.7)	274 (46.3)	62 (38.8)	
Female	416 (55.3)	318 (53.7)	98 (61.3)	
Marital status				<0.001
Never married	188 (25.0)	166 (28.0)	22 (13.8)	
Married/cohabit	493 (65.6)	384 (64.9)	109 (68.6)	
Separated/ddivorced/widowed	70 (9.3)	42 (7.1)	28 (17.6)	
Number of people within the household				0.435
1	60 (8.0)	43 (7.3)	17 (10.6)	
2	156 (20.7)	130 (21.9)	26 (16.3)	
3	94 (12.4)	72 (12.1)	22 (13.8)	
4	198 (26.4)	156 (26.3)	42 (26.3)	
5	165 (21.9)	132 (22.3)	33 (20.6)	
6 or above	80 (10.6)	60 (10.1)	20 (12.5)	
Categories of family members				
16 years or under				0.001
0	536 (71.2)	439 (74.2)	97 (60.2)	
1–4	217 (28.8)	153 (25.8)	64 (39.8)	
17–64 years old, with chronic illnesses or disabilities				0.127
0	721 (95.9)	571 (96.5)	150 (93.8)	
1–2	31 (4.1)	21 (3.5)	10 (6.3)	
65 years or above				0.212
0	621 (82.7)	494 (83.6)	127 (79.4)	
1–2	130 (17.3)	97 (16.4)	33 (20.6)	
Education level				<0.001
Primary or below	166 (22.3)	112 (19.1)	54 (33.8)	
Secondary	351 (47.1)	269 (46.0)	82 (51.2)	
Tertiary or above	228 (30.6)	204 (34.9)	24 (15.0)	
Social security				<0.001
Yes	28 (3.7)	12 (2.0)	16 (10.0)	
No	724 (96.3)	580 (98.0)	144 (90.0)	
Place of birth				<0.001
Hong Kong	426 (56.7)	363 (61.4)	63 (39.4)	
Others	325 (43.3)	228 (38.6)	97 (60.6)	
Income poverty				<0.001
Non-income poor	489 (73.8)	399 (77.9)	90 (59.6)	
Income poor	174 (26.2)	113 (22.1)	61 (40.4)	
Worry of COVID-19				<0.001
Worried	433 (57.6)	306 (51.8)	127 (78.9)	
Neutral/not worried	319 (42.4)	285 (48.2)	34 (21.1)	
SF-12				
PCS	52.7±7.3	53.4±6.5	49.9±9.2	<0.001
MCS	57.4±9.0	58.8±7.5	52.3±11.6	<0.001

MCS, mental component summary; PCS, physical component summary.

Table 2 Economic activity, personal protective equipment and hygiene practice by deprivation status

	Total (N (%))	Non-deprived (n (%))	Deprived (n (%))	P value
General economic activity				
Current economic activity status				<0.001
Full-time employee	326 (43.2)	280 (47.3)	46 (28.4)	
Part-time employee	54 (7.2)	37 (6.3)	17 (10.5)	
Self-employed	33 (4.4)	26 (4.4)	7 (4.3)	
Unemployed	45 (6.0)	21 (3.5)	24 (14.8)	
Retired	141 (18.7)	103 (17.4)	38 (23.5)	
Student/homemaker/permanently sick or disabled	155 (20.6)	125 (21.1)	30 (18.5)	
For those under employment (n=413)				
Salary mode				0.042
Monthly	330 (80.5)	282 (82.7)	48 (69.6)	
Daily	34 (8.3)	23 (6.7)	11 (15.9)	
Hourly	43 (10.5)	34 (10.0)	9 (13.0)	
Others	3 (0.7)	2 (0.6)	1 (1.4)	
Have paid annual leave or paid sick leave	312 (75.9)	270 (78.9)	42 (60.9)	0.001
Place of work				0.016
Same district	121 (29.4)	94 (27.4)	27 (39.1)	
Another district	254 (61.7)	222 (64.7)	32 (46.4)	
No fixed places	34 (8.3)	24 (7.0)	10 (14.5)	
Work at home	3 (0.7)	3 (0.9)	0 (0)	
Changes due to COVID-19				
Change of economic activity status				<0.001
No	611 (82.3)	506 (86.2)	105 (67.7)	
Unemployed/insufficient working hours/uncertain working hours	131 (17.7)	81 (13.8)	50 (32.3)	
For those under employment (n=413)				
Working days outside				0.005
Increase	13 (3.2)	9 (2.6)	4 (5.8)	
No change	244 (59.4)	215 (62.9)	29 (42.0)	
Decrease	154 (37.5)	118 (34.5)	36 (52.2)	
Working days from home				0.180
Increase	83 (20.1)	73 (21.3)	10 (14.3)	
No change or decrease	329 (79.9)	269 (78.7)	60 (85.7)	
Change of income				<0.001
No change or increase	274 (66.7)	243 (71.1)	31 (44.9)	
Decrease	137 (33.3)	99 (28.9)	38 (55.1)	
Being forced to take unpaid leave				0.481
No	321 (90.4)	270 (90.9)	51 (87.9)	
Yes	34 (9.6)	27 (9.1)	7 (12.1)	
Perceived impact on livelihood if did not go outside to work				0.001
Severe impact	60 (14.6)	40 (11.7)	20 (29.0)	
Impacted	115 (28.0)	95 (27.8)	20 (29.0)	
Little impact	58 (14.1)	49 (14.3)	9 (13.0)	
No impact	178 (43.3)	158 (46.2)	20 (29.0)	
Surgical mask				
Current face mask reserves in the household				<0.001
1 month or more	627 (90.1)	510 (92.2)	117 (81.8)	
3 weeks or less	69 (9.9)	43 (7.8)	26 (18.2)	
Difficulty in buying masks				<0.001
Difficult/very difficult	89 (11.9)	64 (10.8)	25 (15.6)	
Neutral	76 (10.1)	49 (8.3)	27 (16.9)	
Easy/very easy	550 (73.2)	453 (76.6)	97 (60.6)	
No need to buy	36 (4.8)	25 (4.2)	11 (6.9)	
Worried about supply				<0.001
Worried	151 (20.1)	83 (14.0)	68 (42.2)	
Not worried/not sure/neutral	602 (79.9)	509 (86.0)	93 (57.8)	
Days of wearing mask in past week				<0.001
0	13 (1.7)	7 (1.2)	6 (3.7)	

Continued

Table 2 Continued

	Total (N (%))	Non-deprived (n (%))	Deprived (n (%))	P value
1–3	59 (7.8)	37 (6.3)	22 (13.7)	
4–6	62 (8.2)	44 (7.4)	18 (11.2)	
7	619 (82.2)	504 (85.1)	115 (71.4)	
Hand sanitiser				
Worried about supply				<0.001
Worried	76 (10.1)	48 (8.1)	28 (17.5)	
Not worried/not sure/neutral	676 (89.9)	544 (91.9)	132 (82.5)	
Days of using hand sanitiser in past week				<0.001
0	49 (6.5)	38 (6.4)	11 (6.8)	
1–3	62 (8.2)	36 (6.1)	26 (16.1)	
4–6	70 (9.3)	48 (8.1)	22 (13.7)	
7	573 (76.0)	471 (79.4)	102 (63.4)	

(total indirect effect: β=−0.027, p=0.017; proportion being mediated=11.46%).

DISCUSSION

In summary, the deprived fared worse in every aspects of life than their non-deprived counterparts after the COVID-19 outbreak. Deprived individuals were more likely to lose their job, work insufficient hours, work in daily and hourly jobs, decrease their number of days working outside and have income cut. For materialistic concerns of PPE and related hygiene practice, the deprived faced more challenges as well, with less reserve of face masks in their household, greater difficulty in getting PPE, more concern over the supply of PPE and lower frequency in using PPE. Even after adjustments for potential confounders, being deprived was also associated with having greater risk of low reserve of face masks in the household, being worried about COVID-19 and job loss/instability after the COVID-19 outbreak. These results are alarming because the deprived individuals had already been more prone to having worse demographic and socioeconomic characteristics even before the outbreak, and the outbreak seems to expose these social inequalities. This is consistent with the observations made in other countries.[2 3 27]

Moreover, we found that the deprived were less healthy both physically and mentally. While these health inequalities have been present even before the emergence of COVID-19,[17 28 29] our results showed that part of the health impact was also contributed via general worry about the disease and changes in terms of economic activity (ie, job loss/instability) that happened after the emergence of COVID-19. Also, the adverse effect of deprivation on mental health was stronger in those under job loss/instability compared with those having no change in economic activity. These observations are consistent with other findings in the USA and Canada.[30 31] This is important because first, it shows that part of the observed health inequalities can be attributed to changes in social conditions as a result of the pandemic even when the number of incident cases were not high or rapidly increasing; and second, the mechanisms that contributed in producing such health inequalities were related to the bigger concerns of the impact of the disease on one's livelihood and economic activity, but not necessarily the materialistic concern over adequacy of face masks and hand sanitisers per se which drew much of the media attention. This is reasonable because the main objective of PPE is primarily disease prevention and health protection against COVID-19 but does not necessarily have direct impact on one's livelihood and economic activity that have been consistently shown to have significant association with health.[32] On the contrary, containment measures of a population have direct impact on the livelihood and economic activity of its members,[33–36] which could have short and longer term impacts on people's health and thus health inequalities. Therefore, our findings confirmed that focusing on the incident cases as the outcome of concern to address health inequalities is like a story half-told and left out important aspects of life that contributes significantly to our health.

As mentioned, early in the outbreak in March, many of the COVID-19 cases were imported by people of higher socioeconomic position who can afford to travel and study abroad. If we used this evidence to claim that the COVID-19 related socioeconomic gradient in health was not present in Hong Kong, then we would severely truncate and distort the reality: health inequalities were in fact contributed by the disease even in a city where incidence is relatively low via other social determinants of health that directly concerned the livelihood and economic activity of the people. In other words, social determinants of health cannot be overlooked in devising and designing any public health-related laws, policies and

Table 3 Crude and adjusted ORs (and their corresponding 95% CIs) for low reserve of face masks in the household, worry of COVID-19 and job loss/instability in relation to deprivation

	Low reserve of face masks in the household		Worry of COVID-19		Job loss/instability	
	Crude OR (95% CI)	Adjusted OR (95% CI)†	Crude OR (95% CI)	Adjusted OR (95% CI)†	Crude OR (95% CI)	Adjusted OR (95% CI)†
Deprivation						
Non-deprived	ref	ref	ref	ref	ref	ref
Deprived	2.66 (1.57 to 4.50)***	2.23 (1.21 to 4.10)**	3.52 (2.33 to 5.33)***	4.07 (2.55 to 6.49)***	2.95 (1.96 to 4.44)***	2.62 (1.41 to 4.88)**

*P value <0.05, **p value <0.01, ***p value <0.001.
†Adjusted for age, gender, marital status, education level, income poverty, current economic activity status and coresidence of family member(s) aged 17–64 years having chronic diseases or disabilities.

Table 4 Crude and adjusted beta coefficients (and their corresponding 95% CIs) of negative COVID-19 related issues in relation to physical and mental health

	PCS		MCS	
	Crude β (95% CI)	Adjusted β (95% CI)†	Crude β (95% CI)	Adjusted β (95% CI)†
Current face mask reserves in the household				
1 month or more	ref	ref	ref	ref
3 weeks or less	−1.96 (−3.69 to −0.23)*	−0.70 (−2.51 to 1.12)	−1.94 (−4.14 to 0.27)	−0.57 (−2.93 to 1.80)
Worry of COVID-19				
Neutral/not worried	Ref	Ref	Ref	Ref
Worried	−0.82 (−1.88 to 0.23)	−0.73 (−1.83 to 0.36)	−2.50 (−3.79 to −1.21)***	−2.18 (−3.54 to −0.82)**
Job loss/instability				
No	Ref	Ref	Ref	Ref
Yes	−0.33 (−1.71 to 1.05)	−0.62 (−2.33 to 1.09)	−2.64 (−4.33 to −0.95)**	−3.61 (−5.72 to −1.49)***

*P value <0.05, **p value <0.01, ***p value <0.001.
†Adjusted for age, gender, marital status, education level, income poverty, current economic activity status and coresidence of family member(s) aged 17–64 years having chronic diseases or disabilities.
MCS, mental component summary; PCS, physical component summary.

measures, and this is coherent with another argument made using a public health ethics framework.[37]

Limitations

First, answers were self-reported by the respondents, and the results may therefore be subject to recall bias. Second, there might be selection bias because our sample tended to be those who agreed to be followed up from earlier data collection time point and were more educated when compared with our previous sample.[38] Nevertheless, results of our analyses were based on age-weighted and sex-weighted sample to better represent the Hong Kong general adult population, and we were especially interested in examining the difference between the deprived and the non-deprived, as well as the associations of different factors with deprivation. Third, the nature of the analyses was cross-sectional; hence, direct temporality was not established. Fourth, we only asked about the general worry about the disease but not specific types of worry they might have regarding the disease. This warrants further in-depth analysis in future studies.

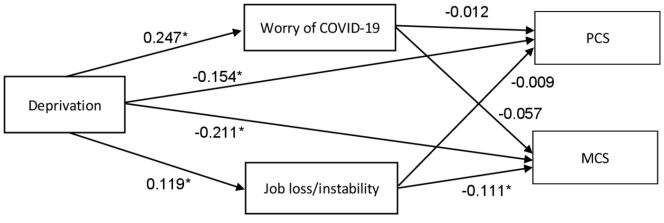

Figure 1 Path analysis for association between deprivation and physical and mental health (direct effect), and via worry of COVID-19 and job loss/instability (indirect effects). All coefficients within each path were standardised and estimated adjusting for age, gender, marital status, education level, income poverty, current economic activity status and coresidence of family member(s) aged 17–64 having chronic diseases or disabilities; *p value <0.05. PCS: adjusted goodness of fit index=0.9916, standardised root mean square residual=0.0013 and Bentler comparative fit index=1.000. MCS: adjusted goodness of fit index=0.9916, standardised root mean square residual=0.0014 and Bentler comparative fit index=1.000. Total indirect effect for PCS=−0.004 (p value=0.707), proportion of effect being mediated=2.55%; total indirect effect for MCS=−0.027 (p value=0.017), proportion of effect being mediated=11.46%. MCS, mental component summary; PCS, physical component summary.

CONCLUSION

Even in a population where the COVID-19 incidence was kept at a relatively low level, health inequality exists and can be partly attributed to the pandemic through people's real concerns over livelihood and economic activity, which were severely affected by the containment measures. Although the COVID-19 incident case number is drawing much of the attention in gauging the severity of the pandemic throughout the world, we should look

What is already known on this subject

- COVID-19 pandemic continues to be rampant, resulting in more than 20 million cases and 0.73 million deaths worldwide as of mid-August 2020.
- In countries with severe COVID-19 outbreaks, a higher rate of incidence or deaths has been widely observed in socially vulnerable groups.
- The expected socioeconomic gradient in health impact that happened in other countries with high COVID-19 incidence did not seem to exist in Hong Kong when focusing on COVID-19 specific incidence in the initial wave of outbreak.

What this study adds

- The deprived fared worse in every aspects of life in terms of economic activity, personal protective equipment, personal hygiene practice, as well as well-being and health than the non-deprived after the COVID-19 outbreak.
- Even in a population where the COVID-19 incidence was relatively low, part of the observed health inequality can be attributed to the pandemic and its related containment measures, through people's concerns over their livelihood and economic activity.
- We confirmed that focusing on the incident cases as the outcome of concern left out important aspects of life that contributes significantly to our health and cannot adequately address COVID-19 related health inequalities.

beyond this health outcome if indeed we espouse to address and reduce COVID-19 related health inequalities in the wider society. Socioeconomic impacts as a result of containment measures will have short-term and longer term health impacts that will risk widening health inequalities unless mitigation strategies are developed.

Acknowledgements We would like to thank all staff and colleagues at CUHK Institute of Health Equity for their support in this research project. RY-NC is currently an International Health Policy Fellow of the National Academy of Medicine, USA.

Contributors All authors contributed to the write-up of this manuscript. RY-NC oversaw the study and is responsible for the conceptualisation of the study, study design, data collection, data analysis, data interpretation and led the write-up of the manuscript. SYSW and DC are responsible for the data collection, data analysis and data interpretation. GK-KC, MM, JA, PG, HW, EL, JW and E-KY are responsible for the data interpretation.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study has been approved by the Joint CUHK-NTEC Clinical Research Ethics Committee in May 2020.

Data availability statement Data are available upon reasonable request. The data that support the findings of this study are available on request from the corresponding author, RY-NC. The data are not publicly available due to containing information that could compromise the privacy of research participants.

ORCID iDs
Roger Yat-Nork Chung http://orcid.org/0000-0003-4407-8208
Gary Ka-Ki Chung http://orcid.org/0000-0002-8652-212X

REFERENCES

1 Johns Hopkins University (JHU). Coronavirus COVID-19 global cases by the center for systems science and engineering (CSSE).
2 Marmot M, Allen J. COVID-19: exposing and amplifying inequalities. *J Epidemiol Community Health* 2020;74:681–2.
3 Dorn Avan, Cooney RE, Sabin ML. COVID-19 exacerbating inequalities in the US. *Lancet* 2020;395:1243–4.
4 Khalatbari-Soltani S, Cumming RC, Delpierre C, *et al*. Importance of collecting data on socioeconomic determinants from the early stage of the COVID-19 outbreak onwards. *J Epidemiol Community Health* 2020;74:620–3.
5 Batty GD, Deary IJ, Luciano M, *et al*. Psychosocial factors and hospitalisations for COVID-19: prospective cohort study based on a community sample. *Brain Behav Immun* 2020;89:569–78.
6 Garcia MA, Homan PA, Garcia C. The Color of COVID-19: Structural Racism and the Pandemic's Disproportionate Impact on Older Racial and Ethnic Minorities. *J Gerontol B Psychol Sci Soc Sci* 2020.
7 Laurencin CT, McClinton A. The COVID-19 pandemic: a call to action to identify and address racial and ethnic disparities. *J Racial Ethn Health Disparities* 2020;7:398–402.
8 Lassale C, Gaye B, Hamer M, *et al*. Ethnic disparities in hospitalisation for COVID-19 in England: the role of socioeconomic factors, mental health, and inflammatory and pro-inflammatory factors in a community-based cohort study. *Brain Behav Immun* 2020;88:44–9.
9 Office for National Statistics. *Coronavirus (COVID-19) related deaths by occupation, England and Wales: deaths registered up to and including 20 April 2020*. UK: Office for National Statistics, 2020.
10 Office for National Statistics. *Coronavirus (COVID-19) related deaths by ethnic group, England and Wales: 2 March 2020 to 10 April 2020*. UK: Office for National Statistics, 2020.
11 Chung GK-K, Dong D, Wong SY-S, *et al*. Perceived poverty and health, and their roles in the poverty-health vicious cycle: a qualitative study of major stakeholders in the healthcare setting in Hong Kong. *Int J Equity Health* 2020;19:13.
12 Census and Statistics Department. Population of Hong Kong in 2019 2020.
13 Census and Statistics Department. Thematic report: household income distribution in Hong Kong. Hong Kong 2017.
14 Centre for Health Protection. Latest situation of cases of COVID-19 2020.
15 Cruz CJP, Ganly R, Li Z, *et al*. Exploring the young demographic profile of COVID-19 cases in Hong Kong: evidence from migration and travel history data. *PLoS One* 2020;15:e0235306.
16 Chung RY-N, Dong D, Li MM. Socioeconomic gradient in health and the covid-19 outbreak. *BMJ* 2020;369:m1329.
17 Chung RY-N, Chung GK-K, Gordon D, *et al*. Deprivation is associated with worse physical and mental health beyond income poverty: a population-based household survey among Chinese adults. *Qual Life Res* 2018;27:2127–35.
18 Wong SY-S, Chung RY-N, Chan D, *et al*. What are the financial barriers to medical care among the poor, the sick and the disabled in the special administrative region of China? *PLoS One* 2018;13:e0205794.
19 Chung GK-K, Chung RY-N, Chan DC-C, *et al*. The independent role of deprivation in abdominal obesity beyond income poverty. A population-based household survey in Chinese adults. *J Public Health* 2019;41:476–86.
20 Chung RY-N, Chung GK-K, Gordon D, *et al*. Housing affordability effects on physical and mental health: household survey in a population with the world's greatest housing affordability stress. *J Epidemiol Community Health* 2020;74:164–72.
21 Chung GKK, Lai FTT, Chan DC, *et al*. Socioeconomic disadvantages over the life-course and their influence on obesity among older Hong Kong Chinese adults. *Eur J Public Health* 2020;30:1013–8.
22 OECD. Quality review of the OECD database on household incomes and poverty and the OECD earnings database Part I. 2012.
23 Townsend P. Deprivation. *J Soc Policy* 1987;16:125–46.
24 Mack J, Lansley S. *Poor Britain*. London: Allen and Unwin, 1985.
25 Lam ETP, Lam CLK, Fong DYT, *et al*. Is the SF-12 version 2 health survey a valid and equivalent substitute for the SF-36 version 2 health survey for the Chinese? *J Eval Clin Pract* 2013;19:200–8.
26 Lam CL, Wong CK, Lam ET. Population norm of Chinese (HK) SF-12 health survey_ version 2 of Chinese adults in Hong Kong. *HK Pract* 2010;32:77–86.
27 Glover RE, van Schalkwyk MCI, Akl EA, *et al*. A framework for identifying and mitigating the equity harms of COVID-19 policy interventions. *J Clin Epidemiol* 2020;128:35–48.
28 Chung RY, Mercer S, Lai FTT, *et al*. Socioeconomic determinants of multimorbidity: a population-based household survey of Hong Kong Chinese. *PLoS One* 2015;10:e0140040.
29 Chung RY, Wong SY. Health inequality in Hong Kong. *China Review* 2015;15:91–118.
30 Taylor S, Landry CA, Paluszek MM, *et al*. COVID stress syndrome: concept, structure, and correlates. *Depress Anxiety* 2020;37:706–14.
31 Wilson JM, Lee J, Fitzgerald HN, *et al*. Job insecurity and financial concern during the COVID-19 pandemic are associated with worse mental health. *J Occup Environ Med* 2020;62:686–91.
32 Marmot M, Allen J, Goldblatt P. *Fair society, healthy lives*. London: University College London, 2010.
33 Nicola M, Alsafi Z, Sohrabi C, *et al*. The socio-economic implications of the coronavirus pandemic (COVID-19): a review. *Int J Surg* 2020;78:185–93.
34 Mukhtar S. Psychological health during the coronavirus disease 2019 pandemic outbreak. *Int J Soc Psychiatry* 2020;66:512–6.
35 Williams SN, Armitage CJ, Tampe T, *et al*. Public perceptions and experiences of social distancing and social isolation during the COVID-19 pandemic: a UK-based focus group study. *BMJ Open* 2020;10:e039334.
36 Guo J, Feng XL, Wang XH, *et al*. Coping with COVID-19: exposure to COVID-19 and negative impact on Livelihood predict elevated mental health problems in Chinese adults. *Int J Environ Res Public Health* 2020;17:17.
37 Chung RY-N, Erler A, Li H-L, *et al*. Using a public health ethics framework to Unpick discrimination in COVID-19 responses. *Am J Bioeth* 2020;20:114–6.
38 Griffith GJ, Morris TT, Tudball MJ, *et al*. Collider bias undermines our understanding of COVID-19 disease risk and severity. *Nat Commun* 2020;11:5749.