Depression and post-traumatic stress during major social unrest in Hong Kong: a 10-year prospective cohort study

Michael Y Ni, Xiaoxin I Yao, Kathy S M Leung, Cynthia Yau, Candi M C Leung, Phyllis Lun, Francis P Flores, Wing Chung Chang, Benjamin J Cowling, Gabriel M Leung

Summary

Background Hong Kong has been embroiled in increasingly violent social unrest since June, 2019. We examined the associated population mental health burden, risk factors, and health-care needs.

Methods In a population-based prospective cohort, adult participants aged 18 years or older were assessed at nine timepoints from 2009. Probable depression was measured using the Patient Health Questionnaire-9 (score ≥10) and suspected post-traumatic stress disorder (PTSD) by the PTSD Checklist—Civilian Version (score ≥14), plus direct exposure to traumatic events related to the ongoing social unrest. We used multivariable logistic regression to identify factors associated with both outcomes, adjusting for doctor-diagnosed depression or anxiety disorders before the unrest. On the basis of routine service statistics and respondents' intention to seek professional care, we projected the number of additional ambulatory specialist psychiatric visits required.

Findings After the two baseline surveys, we followed up random subsets of 1213–1736 adults at each timepoint. Probable depression was reported by 11·2% (95% CI 9·8–12·7) of participants in 2019, compared with 1·9% (1·6–2·1) during 2009–14 and 6·5% (5·3–7·6) in 2017 after the Occupy Central Movement and before the current unrest. Prevalence of suspected PTSD in 2019 was estimated to be 12·8% (11·2–14·4). Age, sex, educational attainment, or household income were not associated with either outcome, whereas heavy social media use (≥2 h per day) was associated with both. Political attitude or protest participation was not associated with probable depression, but neutrality towards the extradition bill approximately halved the risk of suspected PTSD. Family support mitigated against probable depression. We estimated that the mental health burden identified would translate into roughly an excess 12% service requirement to the public sector queue or equivalent.

Interpretation We have identified a major mental health burden during the social unrest in Hong Kong, which will require substantial increases in service surge capacity. Health-care and social care professionals should be vigilant in recognising possible mental health sequelae. In a world of increasing unrest, our findings might have implications for service planning to better protect population mental health globally.

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Introduction

Protests, riots, and other forms of collective actions have taken place in more than 180 countries over the past half-century, and these countries account for 99% of the world's population.[1–3] Social unrest is rising globally,[2] including in large, prosperous cities such as Barcelona, Delhi, Paris, and Santiago, all of which experienced social unrest in 2019. Despite this extensive history and widespread geographies, social unrest as an emerging sociopolitical determinant of population mental health remains largely unassessed.[4]

Hong Kong is known for having the longest life expectancy in the world, for its economic prosperity, and, until recently, as a Chinese city where peaceful protests take place freely and frequently.[3,5] The two largest cases of social unrest since Hong Kong's repatriation in 1997—indeed, since the 1967 riots[5]—are the 2014 Occupy Central/Umbrella Movement, and the ongoing social unrest that began in 2019 in response to the proposed extradition bill (which has since been withdrawn). While the 2014 Occupy Central Movement took inspiration from Occupy Wall Street,[6] the ongoing 2019–20 social unrest has inspired other protests and has spread to major cities globally, with rallies supporting or in opposition of the pro-democracy movement in Hong Kong having taken place in Australia, Canada, France, South Korea, the UK, and the USA, among others.[7,8] Therefore, this globalisation of protests can and does spread rapidly, carrying with it a potential mental health burden on the whole population, irrespective of whether individuals participate in the protests.

The 2014 protests were a largely non-violent civil disobedience campaign that blocked parts of the city centre for 79 days with no reported deaths, shooting, or arson.[9] At the time of publication, the ongoing social unrest is entering its seventh month (figure 1), covers all districts, and has seen escalating levels of violence, involving arson, assault, and vandalism, but no looting.[10]

Research in context

Evidence before this study

We searched PubMed, Web of Science, PsycINFO, and CINAHL Plus for studies published from the inception of each database to Nov 7, 2019, on collective actions and mental health. We used the following search terms with no language restrictions for PubMed: ((“civil disorders”[MeSH] OR “protest”[All Fields] OR “riot”[All Fields] OR “civil conflict” [All Fields] OR “revolution”[All Fields] OR “armed conflicts”[MeSH] OR “civil disobedience”[All Fields] OR “demonstration”[All Fields] OR “social movement”[All Fields] OR “political movement”[All Fields] OR “campaign”[All Fields]) AND (“mental health”[MeSH] OR “mental disorders”[MeSH] OR “depression”[MeSH] OR “depressive disorder”[MeSH] OR “post-traumatic stress disorder”[MeSH])), and adapted the search string for other databases. Only one study examined the longitudinal patterns and predictors of mental health in the general population following a collective action, which was a previous study from the present prospective cohort. We have previously shown that 8·0% of the general population developed persistent moderate depression 1 year after 2014 Occupy Central/Umbrella Movement in Hong Kong. Depressive and post-traumatic symptoms persisted over 18 months after the 2014 Ferguson unrest for both citizens and law enforcement in the USA. Depressive symptoms increased during the 2015 Baltimore unrest and returned to baseline 5 months after the unrest. For post-traumatic stress disorder (PTSD), probability samples in the general population were restricted to riots, where the prevalence of PTSD ranged from 4% to 41%. Risk factors for depression and PTSD included women, lower socioeconomic status, and the level of violence and media exposure. Health service needs following a collective action are largely undocumented.

Added value of this study

Using a large population-based prospective cohort with more than 10 years of longitudinal data, we assessed the population mental health burden, risk factors, and health-care needs of the 2019–20 social unrest and compared the findings with baseline data from 2009–14 and from the 2014 Occupy Central/Umbrella Movement protests. Here, we provide evidence on the high prevalence of probable depression and suspected PTSD during the major social unrest that has been ongoing in Hong Kong since 2019. One in five adults reported probable depression or suspected PTSD during the social unrest, which is comparable to those experiencing large-scale disasters, armed conflicts, or terrorist attacks. Heavy social media use (≥2 h per day), particularly social media apps widely used by protesters, was associated with both probable depression and suspected PTSD, while family support mitigated against probable depression. We estimated that the mental health burden identified would translate into an excess 12% service requirement to the public sector queue or equivalent.

Implications of all the available evidence

Social unrest is rising globally, including in large prosperous cities such as Barcelona, Delhi, Paris, and Santiago, with rallies around the ongoing unrest in Hong Kong spreading to major cities globally. Despite the extensive history, social unrest as an emerging sociopolitical determinant of population mental health remains largely unassessed and is an important line of inquiry. To our knowledge, this is the largest and longest prospective cohort study on collective actions and mental health. We found a major and pervasive mental health burden during the 2019–20 Hong Kong social unrest, which will require substantial increases in service surge capacity in both the health and social sectors. Health-care and social care professionals need to be vigilant in recognising possible psychiatric sequelae during and after widespread unrest. This includes potential spillover effects, where those who have not participated in the protests can also be affected. Fewer than half of affected individuals intended to seek professional care. In particular, those with suspected PTSD, unmarried younger men, or those with low family support were also more likely to report privacy concerns that would deter them from seeking professional help. These subgroups deserve focused attention from the health and social sectors. In a world of increasing unrest, our findings may have implications for service planning to better protect population mental health globally.

The authorities have deployed tear gas, rubber bullets, and live ammunition (table). Apart from direct physical injuries, the potential population mental health impact has not yet been reported.

Using a large population-based prospective cohort with nine waves of longitudinal data over 10 years, we assessed the population mental health burden, risk factors, and health-care needs of the 2019–20 social unrest and compared the findings with those of the 2014 Occupy Central protests, with baseline data from 2009–14.

Methods

Study design and participants

Our sample was drawn from the FAMILY Cohort, a prospective population-based study of physical, mental, and social wellbeing at the individual, household, and neighbourhood levels in Hong Kong.[16] The sampling unit was a family living in the same household. The sample was obtained by stratified random sampling of households from all 18 districts with sample sizes proportionate to each of the district populations. For each district, we obtained a random sample based on a complete list of living quarters provided by the Government Census and Statistics Department in Hong Kong.[17] Wave 1 of the study began with enrolment of 18 045 adults and adolescents (aged ≥15 years) and 1488 children (aged 10–14 years) between March, 2009, and April, 2011, and wave 2 took place from August, 2011, to March, 2014.[17] We subsequently randomly sampled members of wave 2 to measure changes in population mental health and associated factors over a

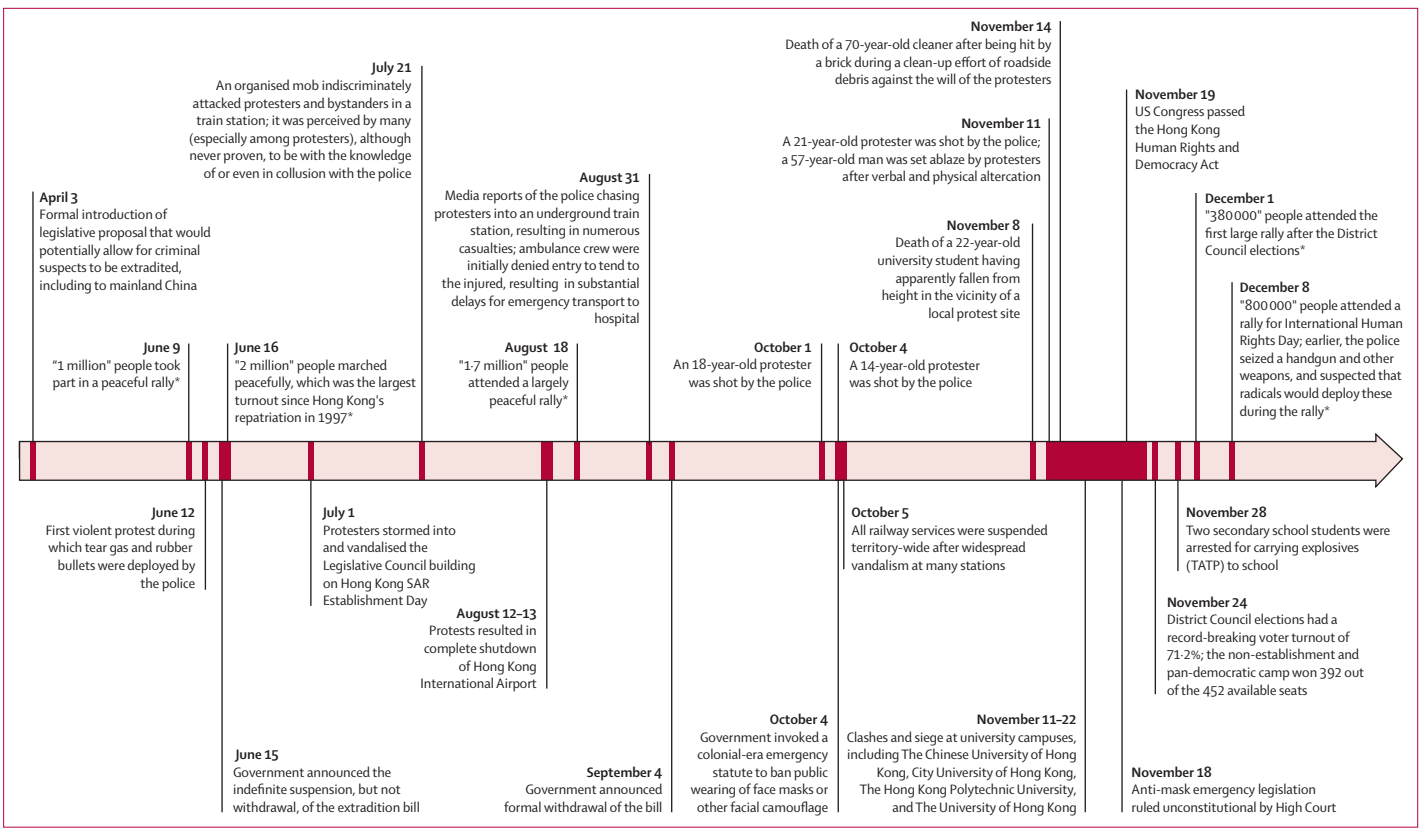


Figure 1: **Chronology of the Hong Kong social unrest in 2019**
Chronology of events from April 1 to Dec 8, 2019. SAR=special administrative region. TATP=triacetone triperoxide. *For rallies on June 9, June 16, August 18, December 1, and December 8, the total number of participants was estimated by the organisers. The police estimated the peak (as opposed to total) number of participants for these rallies as 240 000, 338 000, 128 000, 16 000, and 183 000 people, respectively.

10-year period (appendix p 2). To date, we have collected data at nine timepoints. Participants were surveyed at baseline (waves 1 and 2), during the 2014 Occupy Central Movement (waves 3 and 4), after Occupy Central (waves 5, 6, and 7), and during the 2019–20 social unrest (waves 8 and 9). We oversampled young adults aged 18–35 years from the cohort during Occupy Central in 2014 and the 2019–20 social unrest, due to higher levels of support of the protests within this demographic group.[18] We also randomly sampled additional participants aged 18 years or older from the cohort in waves 4, 7, 8, and 9 as replenishment samples over the 10-year period. In each subsequent wave, we calculated cooperation rates (defined as the proportion of completed interviews among all eligible participants that were contacted) and response rates according to prevailing accepted standards.[19] Informed consent was obtained from all participants. The study was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster.

	Count or percentage
Deaths and injuries	
Deaths	2
Accident and emergency attendances[11]	>2600
Police injuries[11]	>470
Ammunition	
Live rounds[12]	19
Petrol bombs hurled or seized[10,13,14]	>12 640
Tear gas rounds[12]	>11 100
Rubber bullets[12]	>6200
Arrests[15]	
Total	>5800
Age distribution of arrestees*	
<18 years	15%
18–30 years	66%
>30 years	19%

Data are as of Dec 4, 2019. *Range 11–83 years.[15]

Table: **The Hong Kong social unrest in numbers in 2019**

See **Online** for appendix

Outcomes and covariables

We focused on depression and post-traumatic stress disorder (PTSD), as these are the two most commonly observed mental health outcomes for collective actions, disasters, and armed conflicts.[4,20,21] We assessed depressive symptoms and probable depression (all waves), suicidal

ideation (all waves), PTSD symptoms (waves 5 and 6 [after the 2014 Occupy Central Movement] and waves 8 and 9 [during the 2019–20 social unrest]), suspected PTSD (wave 9), intention to seek professional care (wave 9), attitude towards the extradition bill (wave 8), attendance at mass rallies (wave 8), direct exposure to the unrest (wave 9), time spent on sociopolitical news and events via social media (wave 9), and family support (all waves).

Probable current depression and depressive symptoms in the past 2 weeks were assessed using the Patient Health Questionnaire-9[22] (PHQ-9; panel). Suicidal ideation was assessed using the ninth item of PHQ-9 (panel).[22] Suspected current PTSD and PTSD symptoms were assessed using the six-item PTSD Checklist—Civilian Version (panel).[25] Intention to seek professional care was measured by asking participants whether they would seek professional help for any health problems related to the 2019–20 social unrest. For those responding in the affirmative, we further enquired which specific types of health professionals they might seek help from (clinical psychologists, counsellors, doctors, nurses, social workers, and others), and for those responding in the negative, we asked for the reasons for that response. We assessed attitudes towards the extradition bill by asking whether respondents had been for, against, or neutral towards it. To assess attendance at initial mass rallies, we asked if respondents had joined in the two rallies held on June 9 and 16, 2019 (figure 1). Government approval is required for protests, rallies, or any public gathering, and many subsequent protests were declared illegal assemblies.[29] We therefore did not ask about participation in subsequent protests because this could be potentially incriminating behaviour that could lead to reporting bias. To assess direct exposure to the unrest, we asked respondents whether they had witnessed or been exposed to tear gas, and whether they had witnessed violence or serious injury in relation to the unrest. We assessed time spent on sociopolitical news and events via social media by asking specifically about frequency of access to Facebook, Instagram, LIHKG Forum, and Telegram. LIHKG is a local Reddit-like online forum and Telegram is an encrypted messaging app, and both are widely used social media platforms, particularly among protesters.[30,31] Finally, we assessed family support using the family APGAR questionnaire.[32]

***Panel:* Main outcome measures**

Probable current depression and depressive symptoms

PHQ-9 is a standardised nine-item scale consistent with the diagnostic criteria for major depressive episode in the DSM-5. We considered PHQ-9 as a continuous depressive symptoms score (range 0–27) and a binary indicator for depressive symptoms (PHQ-9 ≥5)[22] and probable major depression (PHQ-9 ≥10).[23] Different levels of depression were indicated with scores of 0–4 (none), 5–9 (probable mild depression), and 10 or greater (probable moderate depression).[22] The PHQ-9 has been shown to be a reliable and valid measurement for depressive symptoms in the local population.[24] We use the term probable because PHQ-9 is a screening instrument and not a diagnostic interview. Nevertheless, a meta-analysis has shown that a score of 10 or more has a sensitivity of 88% and specificity of 85% for the diagnosis of major depression.[23] Participants' mental health history pre-dating the 2019–20 social unrest was defined as the presence of any one of doctor-diagnosed depression or anxiety disorder by self-report.

Suicidal ideation

Participants were asked whether they had, over the previous 2 weeks, had thoughts that they would be better off dead, or of hurting themselves. Participants providing a positive response were considered as having potential suicidal ideation. A clinical psychologist and trained staff contacted participants who reported suicidal ideation following a standardised protocol, and provided counselling, information on community centres for mental wellness, mental health hotlines, and referral to health-care professionals, as appropriate.

PTSD symptoms and suspected PTSD

The PCL-C scores range from 6 to 30. A PCL-C score of at least 14 has a sensitivity of 92% and specificity of 72% for PTSD.[25] We therefore classified a score of at least 14 as PTSD symptoms. A score of at least 14 plus direct exposure to traumatic events related to the social unrest (ie, having witnessed violence, serious injury, tear gas use, or falls from height), in accordance with DSM-5 Criterion A, was classified as suspected PTSD. We use the term suspected because PCL-C is a screening instrument and not a diagnostic interview; additionally, the unrest is ongoing, meaning suspected PTSD might represent substantial psychological distress in response to a stressful event as opposed to true psychopathology.[26,27] This is also consistent with the disease surveillance framework adopted by WHO with likelihood of diagnosis (lowest to highest) ranging from suspected to probable to confirmed.[28]

PHQ-9=Patient Health Questionnaire-9. DSM-5=Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. PTSD=post-traumatic stress disorder. PCL-C=PTSD Checklist—Civilian Version.

Statistical analysis

We estimated the prevalence of probable major depression, suspected PTSD, suicidal ideation, depressive symptoms, and PTSD symptoms across the nine waves of longitudinal surveys. We examined the prevalence of probable depression and suspected PTSD in various sociodemographic subgroups. To account for demographic differences between each survey sample and the underlying population, we applied post-stratification weighting and inverse probability of censoring weighting to the data. Inverse probability weighting was used to account for potential attrition bias in a prospective cohort study.[33] The censoring weights were defined as the inverse of the probability of participating in the study after wave 2, estimated using logistic regression with baseline characteristics.[34] Post-stratification weighting was then applied using raking so that each wave would be representative of the general population.[35] We then used multivariable logistic regression analysis to estimate factors associated with probable depression and suspected PTSD in wave 9 participants, giving results as odds ratios. We additionally adjusted for doctor-diagnosed depression or anxiety disorders before the unrest. Responses to the questions on help-seeking behaviour were weighted to population structure. We made conservative estimates around health-care needs (eg, percentage of patients accessing specialist psychiatric care and follow-up frequency) on the basis of clinical experience. We assumed

a follow-up frequency of every 16 weeks (equivalent to an average of three ambulatory visits over the next year, which is a common norm in the Hospital Authority), and that specialist psychiatric care for those with both probable depression and suspected PTSD would be additive. In each analysis, we used multiple imputation to handle any incomplete data, and combined the results from 20 imputed datasets using Rubin's rule.[36] All analyses were done using R version 3.5.2 and MATLAB 2019b.

Role of the funding source

The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication. MYN, XIY, and GML had access to all the data, and all authors were responsible for the decision to submit the manuscript.

Results

After the two baseline surveys (waves 1 and 2), we followed up random subsets of 1213–1736 of these adults in waves 3–9 (appendix p 2). The median response rate across waves 3–9 was 73·4% (range 70·5–75·2) and the median cooperation rate was 73·7% (61·4–79·4; appendix p 2). The demographic distribution of wave 9 conformed to the original cohort and sociodemographic differences between the weighted samples and the 2016 Hong Kong Population by-census were small[17] (appendix pp 3–4).

After weighting to account for differences between the sample and the population, we estimated that around 0·9 million (95% CI 0·8–1·0) adults in Hong Kong participated in the rally on June 9, 2019, and 1·2 million (1·1–1·3) participated in the rally on June 16, 2019. We estimated that 20·8% of adults surveyed witnessed or were exposed to tear gas and 20·9% witnessed violence or serious injury. In terms of social media use, 21·8% of respondents were non-users, 51·2% spent less than 2 h per day on sociopolitical news and events on social media, and 27·0% spent 2 h or more per day.

In wave 9, during the 2019–20 social unrest, the weighted prevalence of depressive symptoms among adults was 37·4% (95% CI 35·1–39·7) and suicidal ideation was 4·3% (3·3–5·2). Probable depression was reported by 11·2% (9·8–12·7) of participants, which was higher than at any previous timepoint (figure 2). The prevalence of probable depression was low before 2014 (estimated at an average of 1·9% [1·6–2·1] during waves 1 and 2), increased considerably during the 2014 Occupy Central period, and did not appear to decline afterwards (figure 2). In wave 7, the most recent timepoint before the 2019–20 social unrest, the weighted prevalence of probable depression was 6·5% (5·3–7·6). The increase from 1·9% at baseline to 11·2% during the unrest corresponds to an additional 590 000 adults (95% CI 500 000–690 000) with probable depression, or a relative increase of nearly 500%. Similarly, the increase in prevalence from wave 7 to wave 9 corresponds to an additional 300 000 adults (180 000–420 000) with probable depression, or a relative increase of more than 70%.

We measured PTSD symptoms in waves 5, 6, 8, and 9. In wave 5, shortly after the Occupy Central period, the prevalence of PTSD symptoms was 4·9% (95% CI 3·7–6·1), and declined to 2·1% (1·3–3·0) in wave 6 nearly a year later (figure 2). There were very large increases in PTSD symptoms in waves 8 and 9, during the 2019–20 social unrest. In wave 8, the weighted prevalence of PTSD symptoms rose to 16·6% (14·8–18·5) and in wave 9, it rose further to 31·6% (29·4–33·8; figure 2). The increase from 2·1% (in wave 6) to 31·6% (in wave 9) corresponds to an additional 1·9 million (1·7–2·0) adults with PTSD symptoms.

The prevalence of suspected PTSD, defined with the additional requirement of direct exposure to traumatic

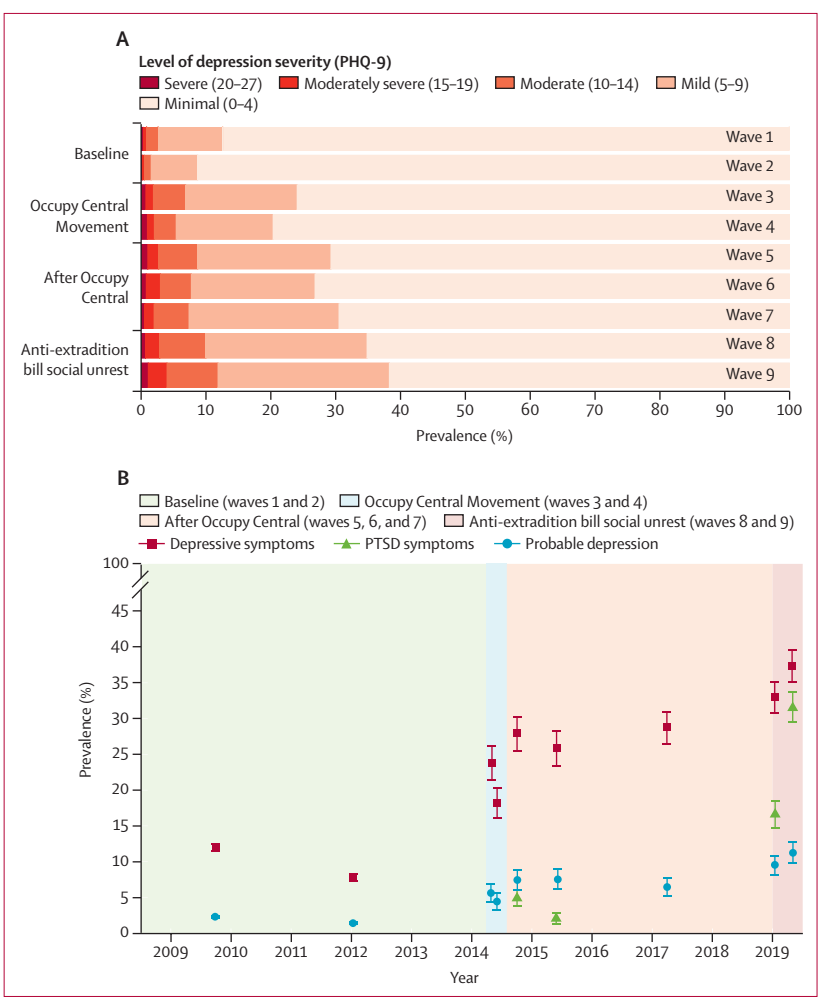
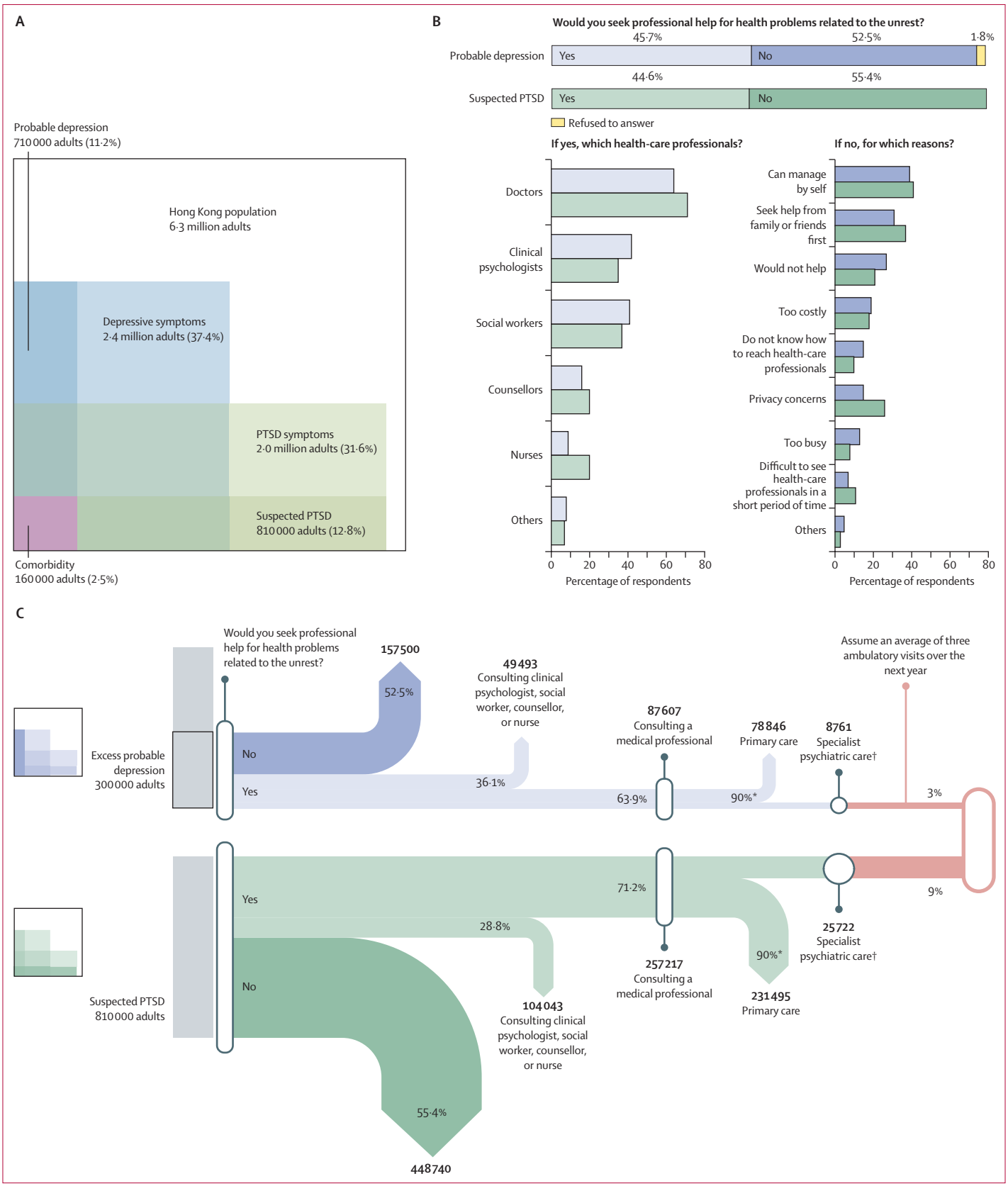


Figure 2: **Evolution of mental health before, during, and after major protests, 2009–19**
(A) Weighted prevalence of depressive sequelae, as measured by the PHQ-9, over the nine waves. (B) Weighted prevalence (95% CI) of probable depression, depressive symptoms, and PTSD symptoms before and during the 2014 Occupy Central Movement and 2019–20 social unrest. PTSD=post-traumatic stress disorder. PHQ-9=Patient Health Questionnaire-9.


A
Probable depression
710 000 adults (11·2%)
Hong Kong population
6·3 million adults
Depressive symptoms
2·4 million adults (37·4%)
PTSD symptoms
2·0 million adults (31·6%)
Suspected PTSD
810 000 adults (12·8%)
Comorbidity
160 000 adults (2·5%)
B
Would you seek professional help for health problems related to the unrest?
Probable depression
45·7%
Yes
52·5%
No
1·8%
Suspected PTSD
44·6%
Yes
55·4%
No
Refused to answer
If yes, which health-care professionals?
Doctors
Clinical psychologists
Social workers
Counsellors
Nurses
Others
0
20
40
60
80
Percentage of respondents
If no, for which reasons?
Can manage by self
Seek help from family or friends first
Would not help
Too costly
Do not know how to reach health-care professionals
Privacy concerns
Too busy
Difficult to see health-care professionals in a short period of time
Others
0
20
40
60
80
Percentage of respondents
C
Excess probable depression
300 000 adults
Would you seek professional help for health problems related to the unrest?
No
52·5%
157 500
Yes
36·1%
49 493
Consulting clinical psychologist, social worker, counsellor, or nurse
63·9%
87 607
Consulting a medical professional
90%*
78 846
Primary care
3%
8761
Specialist psychiatric care†
Assume an average of three ambulatory visits over the next year
Suspected PTSD
810 000 adults
Yes
28·8%
104 043
Consulting clinical psychologist, social worker, counsellor, or nurse
71·2%
257 217
Consulting a medical professional
90%*
231 495
Primary care
9%
25 722
Specialist psychiatric care†
No
55·4%
448 740

events related to the social unrest, was 12·8% (95% CI 11·2–14·4) at wave 9, corresponding to 810 000 adults (95% CI 710 000–910 000) with suspected PTSD (figure 3A). The combined prevalence of either suspected PTSD or probable depression was 21·8% (19·9–23·7), while the prevalence of suspected PTSD and depression comorbidity was 2·5% (1·8–3·3; figure 3A).

Adults aged 60 years or older and participants with lower educational attainment or income reported a higher prevalence of probable depression (figure 4). By contrast, age, educational attainment, and income gradients were reversed for prevalence of suspected PTSD (figure 5). Respondents who were economically inactive or widowed, divorced, or separated had a higher prevalence of probable depression, whereas those who were unemployed and never married reported the highest rates of suspected PTSD. Adjusting for all factors in the multivariable model, as well as doctor-diagnosed depression or anxiety disorders before the unrest, having been widowed, divorced, or separated remained a significant predictor of probable depression (figure 4) whereas the association with suspected PTSD did not hold (figure 5). Political attitudes towards the extradition bill, which triggered the 2019–20 social unrest, or participation in rallies against the bill appear unrelated to probable depression (figure 4). However, respondents who held a neutral view on the bill or did not wish to comment and those who did not take part in either of the initial large rallies reported approximately half the prevalence of suspected PTSD (figure 5). Spending 2 h or more every day on sociopolitical news via social media was strongly associated with probable depression and suspected PTSD (figures 4, 5). In particular, frequent use of Telegram was associated with both probable depression and suspected PTSD, whereas daily use of LIHKG was only associated with suspected PTSD (appendix p 5). In mitigation, family support showed an inverse dose–response gradient with probable depression but not suspected PTSD (figures 4, 5).

When individuals developed any physical or mental health problems related to social unrest, participants who intended to seek help stated a preference for doctors, social workers, clinical psychologists, counsellors, and then nurses (figure 3B). Nearly half of the weighted sample would not seek help from health-care professionals. Reasons included self-management, seeking help from family or friends, and the perception that health-care professionals would not be able to help. Socioeconomic status, political views, and protest participation were not associated with intention to seek help (appendix p 6). Older adults and low family support were associated with being less likely to seek professional help (appendix p 6). Suspected PTSD was associated with less help-seeking (appendix p 6). In the unadjusted model, men and young adults were associated with more privacy concerns that would deter them from seeking professional help (appendix p 7). In the multivariable model, never having been married, low family support, and suspected PTSD were associated with increased odds of having privacy concerns around seeking professional help (appendix p 6).

When considering the estimated 300 000 excess probable depressive cases associated with the 2019–20 social unrest, 45·7% intending to seek professional care would yield around 140 000 potential new patients who needed to be seen (figure 3B, C). Among potential new patients, 63·9% would prefer to consult a medical professional rather than a clinical psychologist, social worker, counsellor, or nurse (figure 3B, C). Even if only 10% of these would eventually require specialist care by a psychiatrist, with the remaining 90% looked after in primary health and social care, around 9000 additional initial specialist consultations would be generated (figure 3C). Assuming a follow-up frequency of every 16 weeks (equivalent to an average of three ambulatory visits over the next year), this would be roughly equivalent to 3% of the annual public sector case load, which saw 873 141 psychiatry specialist episodes recorded in 2017–18 by the Hospital Authority.[37] Similarly, assuming our estimate of 810 000 suspected PTSD cases is accurate, an additional 9% of the public sector annual outpatient case load would be required to meet the need (figure 3C). Together, probable depression and suspected PTSD would roughly add an extra 12% to the public sector queue or equivalent.

Figure 3: **Mental health burden, intention to seek professional help, and potential service need and health system capacity during the 2019–20 social unrest**

(A) Weighted prevalence of mental health outcomes during the 2019–20 social unrest. Areas of rectangles are proportional to the adult population size of Hong Kong. (B) Intention to seek professional help among individuals with probable depression and suspected PTSD for health problems related to the 2019–20 social unrest. For those responding in the affirmative, we further enquired which specific types of health professionals (can choose more than one option), and for those responding in the negative we asked for the reasons. (C) Potential service need and health system capacity during the 2019–20 social unrest. Based on the mental health burden in panel (A) and the proportion of individuals with probable depression or suspected PTSD intending to seek professional care in panel (B), we estimated the potential service need and additional case load during the social unrest. Estimated prevalence and service need for excess cases of probable depression are based only on respondents who answered "Yes" or "No", and omit the 1·8% of respondents who refused to answer. PTSD=post-traumatic stress disorder. *Assumed division of 10% requiring specialist psychiatric care and 90% requiring primary care. †We assume that the specialist psychiatric care for those with both probable depression and suspected PTSD is additive.

Discussion

Our prospective findings show a high prevalence of probable depression and suspected PTSD during the 2019–20 social unrest in Hong Kong. Probable depression is more than five times higher than it was before 2014 and has doubled since the 2014 Occupy Central Movement. During the 2019–20 social unrest, PTSD symptoms increased by a factor of six compared with post Occupy Central. One in five adults now reports probable

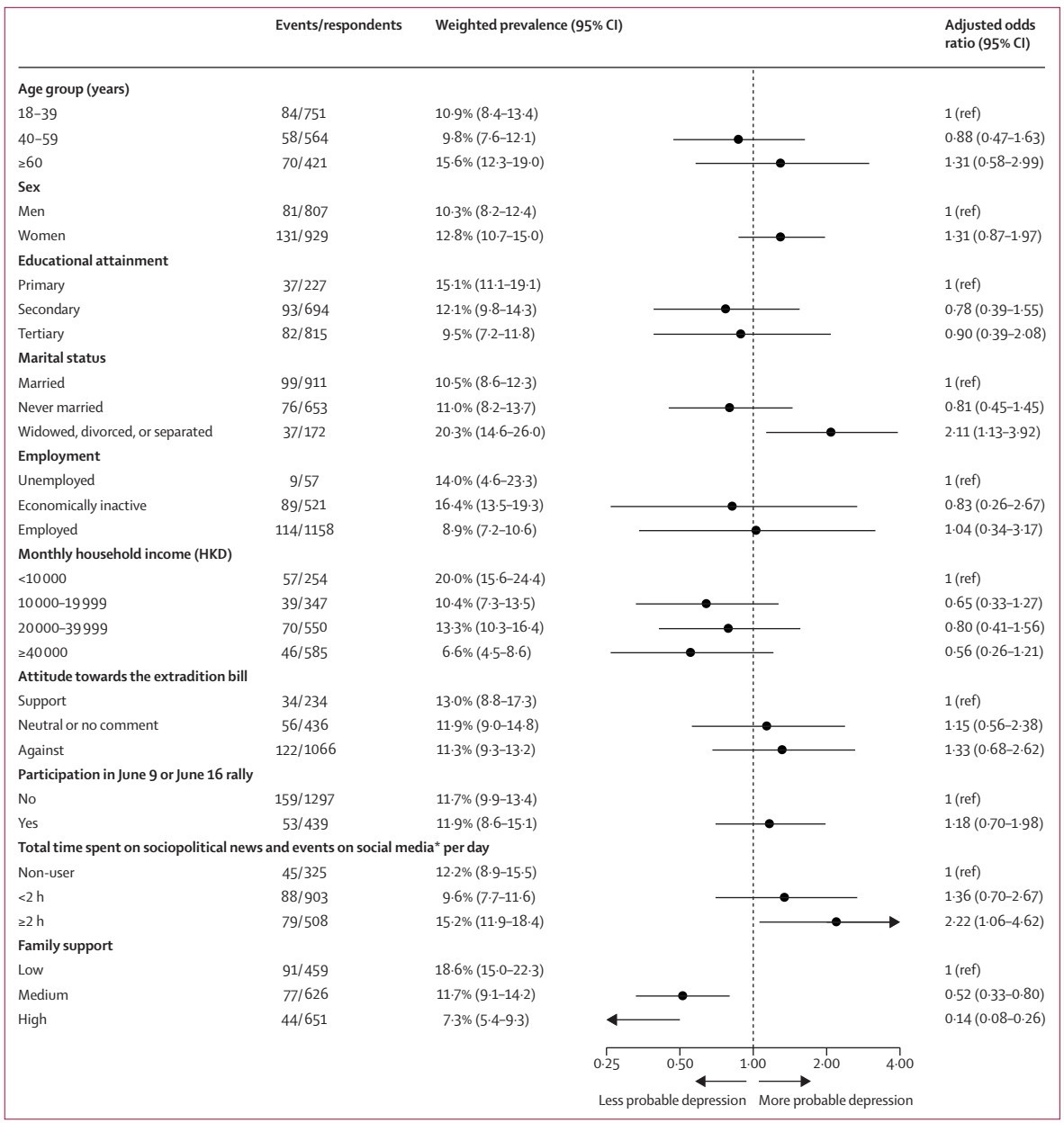


Figure 4: **Burden and risk factors of probable depression associated with the 2019–20 Hong Kong social unrest**
Odds ratios are obtained through multivariable analysis and additionally adjusted for doctor-diagnosed depression or anxiety disorders before the unrest. *Social media platforms include Facebook, Instagram, online forums (eg, Hong Kong Golden Forum and LIHKG Forum), Telegram, WhatsApp, and YouTube.

depression or suspected PTSD, which is comparable to those experiencing armed conflicts (eg, 22·1%),[21] large-scale disasters, or terrorist attacks (eg, 10%).[20]

Notably, these mental health consequences transcended sociodemographics. As would be expected, participation in the two initial mass rallies, which might be predictive of subsequent direct exposure to violent conflicts, were associated with greater odds of suspected PTSD. Heavy politics-related social media use was strongly associated with mental ill health, in particular the preferred social media apps of LIHKG and Telegram widely used by protesters,[30,31] perhaps attributable to the increasingly extreme content (including fake news) and emotional contagion through social networks.[38,39] For suspected PTSD, Telegram was also the main communication tool used in planning and disseminating protest tactics, thus likely to be predictive of participation that would fulfil the direct witness or exposure requirement.[40] On the contrary, the protective role of family support could be explained by its stress buffering function.[9,20]

Fewer than half of those affected intended to seek professional care; how much of the residual self-care

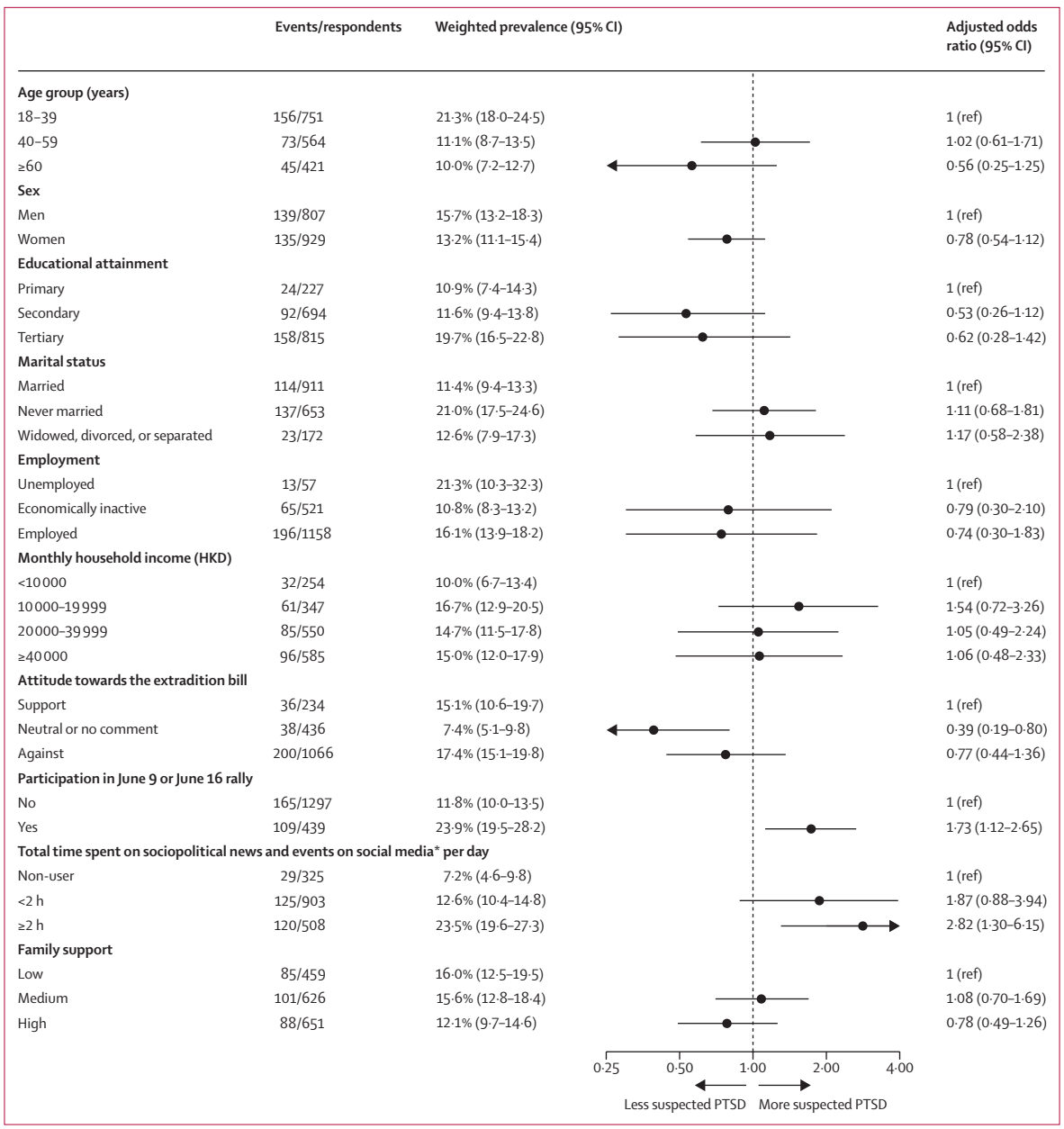


Figure 5: **Burden and risk factors of suspected PTSD associated with the 2019–20 Hong Kong social unrest**
Odds ratios are obtained through multivariable analysis and are additionally adjusted for doctor-diagnosed depression or anxiety disorders before the unrest. PTSD=post-traumatic stress disorder. *Social media platforms include Facebook, Instagram, online forums (eg, Hong Kong Golden Forum and LIHKG Forum), Telegram, WhatsApp, and YouTube.

burden would eventually become unmet need should be carefully monitored. Privacy concerns were cited by more than a fifth of those with suspected PTSD, reflecting mistrust of the authorities in accessing medical records for potential law enforcement purposes.[41] Indeed, some people have avoided seeking medical treatment in Hong Kong due to concerns that doctor–patient confidentiality is compromised.[42]

Our estimates did not account for people younger than 18 years of age. Given that a substantial proportion of the protesters are believed to be teenagers, which is substantiated by the tip-of-the-iceberg arrest statistics of 15% belonging to that age group, the reported prevalence of probable depression and suspected PTSD would be the lower bound of the real population burden. Whereas our sample is representative of the general adult population, we did not purposively sample members of the police. The strength of the police force in 2018 totalled 29 398 people[43] out of Hong Kong's total adult population of 6 320 875,[44] which would translate

into about eight officers who should have been included in our sample, assuming a similar response rate by occupation, which might be less likely given their current 12-h shift duty rosters as part of the "force mobilisation".[45] We can, however, anticipate that their mental health burden would be at least that of the general population, thus potentially presenting another unmeasured downward bias of the reported estimates.

Mental health-care providers should plan for a substantial increase in service needs—tentatively 12% in excess of the current baseline, disregarding inpatient care and non-medical services. We used specialist psychiatric care as an illustrative example because it is the tip of the clinical iceberg. If the surge capacity at the top of the referral tree is inadequate to deal with the mental health burden, then the problem upstream in the referral chain would be compounded by Hong Kong's underdeveloped primary care and social care for mental illness or wellbeing.[46,47] There are major uncertainties around this estimate, given the many necessary assumptions of care-seeking behaviour, spectrum of psychopathology and associated sequelae, and, of course, the ultimate duration and disposition of the ongoing social unrest. While we have cited two major sampling deficiencies that would underestimate the burden and, thus, care need, our survey assessment tools for depression and PTSD—particularly the latter—could have overestimated the excess burden. Probable major depression or suspected PTSD, as measured, might represent substantial psychological distress in response to an abnormal event as opposed to true psychopathology.[26,48] Nevertheless, it would be prudent to plan for a major capacity surge to deal with the anticipated service need. According to a recent meta-analysis, 47% of patients with major depression would remain depressed after 1 year if left untreated.[49] For PTSD, 39·1% would experience a chronic course,[50] with the caveat that the existing literature has been mostly based on single, well defined events (eg, wars, natural disasters, physical or sexual abuse) as opposed to massive ongoing social unrest.[51] While some patients might experience recovery as the social unrest tapers, others whose condition was triggered by the unrest might be unable to recover simply with a change in the external macroenvironment.[9,51]

Psychiatry outpatient waiting time in the public sector, which is responsible for about 76% of specialist care overall,[52] currently ranges from 17 to 64 weeks for routine appointments (accounting for 75% of all cases) across different hospitals. Two thirds of psychiatry specialists and trainees work in the public sector, with the rest in private settings. However, Hong Kong only has half the per-capita psychiatry capacity of the UK—7·2 psychiatrists per 100 000 population compared with 14·6 in the UK.[53] Hong Kong is under-resourced to deal with this excess mental health burden. For simplicity, we did not consider non-medical service needs nor how allied professionals could contribute to alleviating the identified need. This would require a major planning exercise across the health-care and social care sectors, involving both public and private providers in the mixed health-care and social care economy of Hong Kong.[54,55] The planning estimates in our illustrative example concern averages, but the inverse care law probably applies here in particular.[56]

A final major limitation bears mention. Despite our longitudinal design, causality between the 2019–20 social unrest and mental health outcomes cannot and should not be inferred. We examined associations and predictive factors rather than causes of mental ill health because our primary objective was to identify vulnerable groups. Other caveats include the potential attrition bias of any long-term cohort. The application of censoring weights did not appreciably alter results, suggesting that attrition had little impact. Additionally, our family support and social media findings could be accounted for by depressed individuals becoming withdrawn and ruminating on unrest-related news. However, our findings remained following additional adjustment of past mental health history to mitigate the concern of pre-existing psychological vulnerabilities. Nevertheless, there could be residual confounding due to low life satisfaction or pessimism towards sociopolitical developments.[57]

In conclusion, our findings show a major mental health burden associated with the ongoing Hong Kong social unrest. This will require substantial increases in service surge capacity in both the health and social sectors, and in real time. Health-care and social care professionals need to be vigilant in recognising possible psychiatric sequelae during and after widespread unrest, opportunistically during routine interactions and systematically through deliberate planning. The high prevalence in probable depression and suspected PTSD could result in functional impairment for parenting and work, as well as substantial economic costs.[58,59] Public health measures during an unrest include health needs assessment, ensuring safety, and restoring the population's ability to engage in daily routines and community activities.[4,60] The knowledge gap regarding teenagers and police officers cannot be overemphasised and must be redressed urgently. In future, ongoing surveillance and monitoring of the mental health consequences of major social unrest, in addition to current conventions for infectious epidemics, wars, and natural disasters, should become routine as part of preparedness efforts worldwide.

Contributors
GML and MYN conceived and designed the study. MYN, CY, CMCL, PL, and FPF collected the data. MYN, XIY, KSML, and FPF analysed the data. MYN, WCC, BJC, and GML interpreted the data. MYN and GML wrote the first draft of the manuscript. All authors critically revised the manuscript and approved the final version.

Declaration of interests
BJC has received honoraria from Sanofi Pasteur and Roche, outside of the submitted work. All the other authors report no competing interests.

Data sharing
Data obtained for the study will not be made available to others.

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References

1 Banks AS, Wilson KA. Cross-national time-series data archive. Databanks International, ed. https://www.cntsdata.com (accessed July 13, 2018).
2 Ortiz I, Burke S, Berrada M, Cortés H. World Protests 2006–2013. New York: Initiative for Policy Dialogue and Friedrich-Ebert-Stiftung, 2013.
3 The World Bank. World Bank Open Data. 2019. https://data.worldbank.org/indicator/sp.dyn.le00.in?most_recent_value_desc=true (accessed Nov 17, 2019).
4 Ni MY, Kim Y, McDowell I, et al. Mental health during and after protests, riots and revolutions: a systematic review. *Aust N Z J Psychiatry* (in press).
5 Dapiran A. City of protest: a recent history of dissent in Hong Kong. Australia: Penguin Random House Australia, 2017.
6 Lam JTM. The Occupy Central Movement and political reform in Hong Kong. In: Cheng JYS, ed. New trends of political participation in Hong Kong. Hong Kong: City University of Hong Kong Press, 2014: 449–82.
7 BBC News. Hong Kong protests: rival demonstrations spread across globe. Aug 18, 2019. https://www.bbc.com/news/world-49388822 (accessed Nov 17, 2019).
8 Tai C. South China Morning Post. In South Korea, Chinese and Korean students are clashing over Hong Kong protests. Nov 22, 2019. https://www.scmp.com/week-asia/politics/article/3038795/south-korea-chinese-and-korean-students-are-clashing-over-hong (accessed Nov 23, 2019).
9 Ni MY, Li TK, Pang H, et al. Longitudinal patterns and predictors of depression trajectories related to the 2014 Occupy Central/Umbrella Movement in Hong Kong. *Am J Public Health* 2017; **107:** 593–600.
10 Robles P. South China Morning Post. Hong Kong protests: key events from Hong Kong's anti-government protests. Oct 9, 2019; updated Nov 13, 2019. https://multimedia.scmp.com/infographics/news/hong-kong/article/3032146/hong-kong-protests/index.html (accessed Nov 21, 2019).
11 The Government of the Hong Kong SAR. LCQ3: complaints against police officers. Nov 27, 2019. https://www.info.gov.hk/gia/general/201911/27/P2019112700431.htm (accessed Nov 27, 2019).
12 South China Morning Post. Police respond to more menacing mob attacks by bringing out lethal anti-riot weapons not used earlier in unrest. Nov 20, 2019. https://www.scmp.com/news/hong-kong/law-and-crime/article/3038453/police-respond-deadlier-mob-attacks-bringing-out (accessed Nov 22, 2019).
13 South China Morning Post. More than 8000 petrol bombs primed for Hong Kong streets 'found in weapons factory at Chinese University'. Nov 19, 2019. https://www.scmp.com/news/hong-kong/politics/article/3038399/thousands-petrol-bombs-primed-hong-kong-streets-found (accessed Nov 21, 2019).
14 Hong Kong Police Force. The Hong Kong Polytechnic University, petrol bombs, chemicals and weapons. Dec 3, 2019. https://www.facebook.com/HongKongPoliceForce/photos/a.965784490176182/2802505706504042/?type=3&theater (accessed Dec 4, 2019).
15 Hong Kong SAR Security Bureau. LCQ19: statistics on arrestees in public events between June and November. Dec 4, 2019. https://www.info.gov.hk/gia/general/201912/04/P2019120400451.htm (accessed Dec 8, 2019).
16 Ni MY, Yao XI, Cheung F, et al. Determinants of physical, mental, and social well-being: a longitudinal environment-wide association study. *Int J Epidemiol* 2019; published online Dec 23. DOI:10.1093/ije/dyz238.
17 Leung GM, Ni MY, Wong PT, et al. Cohort profile: FAMILY Cohort. *Int J Epidemiol* 2017; **46:** e1.
18 Lee FLF, Yuen S, Tang G. EW. C. Onsite survey findings in Hong Kong's Anti-Extradition Bill protests. Hong Kong: Centre for Communication and Public Opinion Survey, The Chinese University of Hong Kong, 2019.
19 The American Association for Public Opinion Research. Standard definitions: final dispositions of case codes and outcome rates for surveys. 2016. https://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf (accessed Nov 18, 2019).
20 Goldmann E, Galea S. Mental health consequences of disasters. *Annu Rev Public Health* 2014; **35:** 169–83.
21 Charlson F, van Ommeren M, Flaxman A, Cornett J, Whiteford H, Saxena S. New WHO prevalence estimates of mental disorders in conflict settings: a systematic review and meta-analysis. *Lancet* 2019; **394:** 240–48.
22 Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001; **16:** 606–13.
23 Levis B, Benedetti A, Thombs BD. Accuracy of Patient Health Questionnaire-9 (PHQ-9) for screening to detect major depression: individual participant data meta-analysis. *BMJ* 2019; **365:** l1476.
24 Yu X, Tam WWS, Wong PTK, Lam TH, Stewart SM. The Patient Health Questionnaire-9 for measuring depressive symptoms among the general population in Hong Kong. *Compr Psychiatry* 2012; **53:** 95–102.
25 Lang AJ, Stein MB. An abbreviated PTSD checklist for use as a screening instrument in primary care. *Behav Res Ther* 2005; **43:** 585–94.
26 North CS. Current research and recent breakthroughs on the mental health effects of disasters. *Curr Psychiatry Rep* 2014; **16:** 481.
27 North CS, Pfefferbaum B. Research on the mental health effects of terrorism. *JAMA* 2002; **288:** 633–36.
28 WHO. Case definition recommendations for Ebola or Marburg virus diseases. Aug 9, 2014. https://apps.who.int/iris/bitstream/handle/10665/146397/WHO_EVD_CaseDef_14·1_eng.pdf?sequence=1 (accessed Dec 7, 2019).
29 Lew L. South China Morning Post. Police ban of mass Hong Kong protest planned by Civil Human Rights Front upheld on appeal. Aug 30, 2019. https://www.scmp.com/news/hong-kong/politics/article/3025020/police-ban-mass-hong-kong-protest-planned-civil-human (accessed Nov 23, 2019).
30 Ives M, Li K. For Hong Kong's youth, protests are 'a matter of life and death'. June 17, 2019. https://www.nytimes.com/2019/06/17/world/asia/hong-kong-protests-youth.html (accessed Nov 23, 2019).
31 Yeo R. South China Morning Post. Hong Kong protests: how the city's Reddit-like forum LIHKG has become the leading platform for organising demonstrations. Aug 3, 2019. https://www.scmp.com/news/hong-kong/society/article/3021224/hong-kong-protests-how-citys-reddit-forum-lihkg-has-become (accessed Nov 23, 2019).
32 Chan D, Ho S, Donnan S. A survey of family APGAR in Shatin private ownership homes. *Hong Kong Practitioner* 1988; **10:** 3295–99.
33 Howe CJ, Cole SR, Lau B, Napravnik S, Eron JJ Jr. Selection bias due to loss to follow up in cohort studies. *Epidemiology* 2016; **27:** 91–97.
34 Fitzmaurice GM, Laird NM, Ware JH. Applied longitudinal analysis. New Jersey: John Wiley & Sons, 2012.
35 Lumley T. Complex surveys: a guide to analysis using R. New York: John Wiley & Sons, 2011.
36 Molenberghs G, Kenward MG. Missing data in clinical studies. Hoboken: John Wiley & Sons, 2007.
37 Legislative Council of Hong Kong SAR. Replies to initial written questions raised by Finance Committee Members in examining the Estimates of Expenditure 2019–20: Session No: 14. April 11, 2019. https://www.legco.gov.hk/yr18-19/english/fc/fc/w_q/fhb-h-e.pdf (accessed Nov 23, 2019).
38 Kramer ADI, Guillory JE, Hancock JT. Experimental evidence of massive-scale emotional contagion through social networks. *Proc Natl Acad Sci USA* 2014; **111:** 8788–90.
39 VanderWeele TJ, Mathur MB, Chen Y. Media portrayals and public health implications for suicide and other behaviors. *JAMA Psychiatry* 2019; **76:** 891–92.

40 Schectman J. Reuters. Exclusive: messaging app Telegram moves to protect identity of Hong Kong protesters. Aug 31, 2019. https://www.reuters.com/article/us-hongkong-telegram-exclusive/exclusive-messaging-app-telegram-moves-to-protect-identity-of-hong-kong-protesters-idUSKCN1VK2NI#:~:targetText=WASHINGTON%20(Reuters)%20%2D%20Telegram%2C,direct%20knowledge%20of%20the%20effort (accessed Nov 23, 2019).

41 Sum L-k, Cheung E. South China Morning Post. Leaked video exposes how patient data in Hong Kong public hospitals can be accessed by any user without needing a password. June 18, 2019. https://www.scmp.com/news/hong-kong/politics/article/3015075/leaked-video-exposes-how-patient-data-hong-kong-public (accessed Nov 23, 2019).

42 Yuan S. Tensions grow between Hong Kong police and medics. *Lancet* 2019; **394:** 2056.

43 Hong Kong Police Force. Statistics. November, 2019. https://www.police.gov.hk/ppp_en/09_statistics/index.html (accessed Nov 22, 2019).

44 Census and Statistics Department of the Hong Kong SAR. 2016 Population By-census. Main table A119a: population by age, year, sex and marital status. Feb 23, 2018. https://www.bycensus2016.gov.hk/en/bc-mt.html (accessed Nov 22, 2019).

45 Purbrick M. A report of the 2019 Hong Kong protests. *Asian Aff* 2019; **50:** 465–87.

46 Tse S, Ng R, Lam CW. Mental health services in Hong Kong. In: Bhugra D, Tse S, Ng R, N T, eds. Routledge Handbook of Psychiatry in Asia. New York: Routledge; 2015: 155–69.

47 Food and Health Bureau of the Hong Kong SAR. Mental Health Review Report. 2017. https://www.fhb.gov.hk/download/press_and_publications/otherinfo/180500_mhr/e_mhr_full_report.pdf (accessed Dec 12, 2019).

48 Ni MY, Li TK, Pang H, et al. Direct participation in and indirect exposure to the Occupy Central Movement and depressive symptoms: a longitudinal study of Hong Kong adults. *Am J Epidemiol* 2016; **184:** 636–43.

49 Whiteford HA, Harris MG, McKeon G, et al. Estimating remission from untreated major depression: a systematic review and meta-analysis. *Psychol Med* 2013; **43:** 1569–85.

50 Santiago PN, Ursano RJ, Gray CL, et al. A systematic review of PTSD prevalence and trajectories in DSM-5 defined trauma exposed populations: intentional and non-intentional traumatic events. *PLoS One* 2013; **8:** e59236.

51 Galovski TE, Peterson ZD, Fox-Galalis A. Trajectories of posttraumatic stress and depression in police and community members following the violence during civil unrest in Ferguson, Missouri. *Am J Community Psychol* 2018; **62:** 433–48.

52 Lee PY, Johnston JM, Lee PSL, et al. Hong Kong domestic health spending: financial years 1989/90 to 2016/17. *Hong Kong Med J* 2019; **25** (suppl 6): 1–24.

53 WHO. Mental Health Atlas 2014 country profiles. 2015. https://www.who.int/mental_health/evidence/atlas/profiles-2014/gbr.pdf?ua=1 (accessed Nov 24, 2019).

54 Leung GM, Bacon-Shone J, eds. Hong Kong's health system: reflections, perspectives and visions. Hong Kong: Hong Kong University Press, 2010.

55 Leung GM, Wong IOL, Chan W-S, Choi S, Lo S-V. The ecology of health care in Hong Kong. *Soc Sci Med* 2005; **61:** 577–90.

56 Hart JT. The inverse care law. *Lancet* 1971; **297:** 405–12.

57 Yang X, She R, Lau MMC, Lau JTF. Anticipated socio-political developments and related personal responses as structural determinants of mental health problems: a population-based study. *Int J Soc Psychiatry* 2019; published online Oct 14. DOI:10.11777/0020764019879948.

58 Muzik M, Morelen D, Hruschak J, Rosenblum KL, Bocknek E, Beeghly M. Psychopathology and parenting: an examination of perceived and observed parenting in mothers with depression and PTSD. *J Affect Disord* 2017; **207:** 242–50.

59 Chisholm D, Sweeny K, Sheehan P, et al. Scaling-up treatment of depression and anxiety: a global return on investment analysis. *Lancet Psychiatry* 2016; **3:** 415–24.

60 Yimgang DP, Wang Y, Paik G, Hager ER, Black MM. Civil unrest in the context of chronic community violence: impact on maternal depressive symptoms. *Am J Public Health* 2017; **107:** 1455–62.