

# BMJ Open

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

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

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

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

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

# BMJ Open

## Injury mortality changes at the COVID-19 period in Guangdong, China

|                               |  |
|-------------------------------|--|
| Journal:                      | <i>BMJ Open</i>  |
| Manuscript ID                 | bmjopen-2020-045317  |
| Article Type:                 | Original research  |
| Date Submitted by the Author: | 29-Sep-2020  |
| Complete List of Authors:     | Zheng, Xue-yan; Guangdong Center for Disease Control and Prevention, Institute of Non-communicable disease control and prevention;<br>Tang, Si-li; Southern Medical University, School of Public Health<br>Ma, Shu-li; Guangdong Pharmaceutical University, School of Public Health<br>Guan, Weijie; First Affiliated Hospital of Guangzhou Medical College, State Key Laboratory of Respiratory Disease and National Clinical Research Center for Respiratory Disease<br>Xu, Xiaojun; Guangdong Center for Disease Control and Prevention, Institute of Control and Prevention for Chronic Non-infective Disease<br>Xu, Haofeng; Guangdong Center for Disease Control and Prevention, Institute of Control and Prevention for Chronic Non-infective Disease<br>Xu, Ying-shan; Guangdong Center for Disease Control and Prevention, Institute of Control and Prevention for Chronic Non-infective Disease<br>Xu, Yan-jun; Guangdong Center for Disease Control and Prevention<br>Lin, Li-feng; Guangdong Center for Disease Control and Prevention |
| Keywords:                     | EPIDEMIOLOGY, PUBLIC HEALTH, Suicide & self-harm < PSYCHIATRY  |
|                               |  |

SCHOLARONE™  
Manuscripts



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

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

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

## Injury mortality changes at the COVID-19 period in Guangdong, China

Xue-yan Zheng<sup>1#</sup>, Si-li Tang<sup>1,2#</sup>, Shu-li Ma<sup>1,3#</sup>, Wei-jie Guan<sup>4#</sup>, Xiao-jun Xu<sup>1</sup>, Hao-feng Xu<sup>1</sup>, Ying-shan Xu<sup>1</sup>, Yan-jun Xu<sup>1\*</sup>, Li-feng Lin<sup>1,2\*</sup>

1 Guangdong provincial center for disease control and prevention, Guangdong, China.

2 School of Public Health, Southern Medical University, Guangdong, China

3 Department of Epidemiology and Biostatistics, School of Public Health, Guangdong Pharmaceutical University, Guangzhou, China.

4 State Key Laboratory of Respiratory Disease and National Clinical Research Center for Respiratory Disease, the First Affiliated Hospital of Guangzhou Medical University, Guangzhou Medical University, Guangzhou, China.

# Xue-yan Zheng, Si-li Tang, Shu-li Ma and Wei-jie Guan shared co-first authorship.

\* Correspondence author 1: Li-feng Lin. Guangdong provincial center for disease control and prevention, Guangdong, China. Address: 160 Qunxian Road, Panyu district, Guangzhou, Guangdong, China. Fax: 020-31051821, Phone: 020-31051821, E-mail: [1396320174@qq.com](mailto:1396320174@qq.com).

Correspondence author 2: Yan-jun Xu. Guangdong provincial center for disease control and prevention, Guangdong, China. Address: 160 Qunxian Road, Panyu district, Guangzhou, Guangdong, China. Fax: 020-31051492, Phone: 020-31051353, E-mail: [759888406@qq.com](mailto:759888406@qq.com).

Word count, excluding title page, abstract, references, figures and tables: 2157

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

29

**Abstract**

**Objective:** To ascertain the injury mortality changes during the COVID-19 period in southern China

**Methods:** We conducted a population-based retrospective analysis to compare mortality changes of different injury categories including injury, transport injuries, poisonings, falls/fire/heat/hot substances, drowning, self-harm and interpersonal violence based on sex, age groups between study and control period in Guangdong, China. We used negative binomial model to explore the associations of deaths with socio-demographic factors including sex, age and duration.

**Results:** The injury mortality in Guangdong province decreased significantly from 28.65 per 100000 people in 2019 control period to 23.24 per 100000 people in COVID-19 pandemic period. Similar results were found in lower categories of injury. Mortality changes of self-harm had statistically significant increase in 0-14 age groups. Though mortality changes in some groups did not have statistical significances, some increases were noteworthy, i.e. self-harm, transport injury, falls, in 70-79 age group.

**Conclusion:** The COVID-19 pandemic was associated with decreased mortality of all injury, transport injury and drowning. However, increased mortality of falls, fire/heat/hot substances injury and self-harm in specific age population during the COVID-19 period, warrant selective, indicated and universal interventions for public.

50

**Key Words:** Injury; Mortality; COVID-19

52

53

54

55

56

57

1  
2  
3  
4 5859 **Strengths and limitations of this study**

60 1. This is the first study to demonstrate multiple injury mortality at different age and  
61 sex population at provincial level in China, making comparisons between COVID-19  
62 pandemic period and control period.

63 2. The total and lower categories of injury mortality in Guangdong province  
64 decreased significantly in COVID-19 pandemic period, when comparing with 2019  
65 control period.

66 3. Mortality changes of self-harm had statistically significant increase in 0-14 age  
67 groups.

68 4. The causative effect of the COVID-19 epidemic on injury mortality was limited  
69 owing to the limitation of the observational study, and the lack of injury incidence  
70 data.

71

72

73

74

75

76

77

78

79

80

81

82

83

84

85

86

87

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

88

## 89 Introduction

90 As a consequence of Coronavirus Disease 2019 (COVID-19) pandemic, strict  
91 quarantine measures are introduced to stop the COVID-19 transmission in China,  
92 even for people who have not contracted COVID-19 patients.[1] Guangdong is a  
93 major province of China which suffered from one of the most massive epidemics of  
94 COVID-19 in China. The government had imposed quarantine and lockdown  
95 measures in an unprecedented effort to control the COVID-19 epidemic. Except for  
96 those who were responsible for providing living necessities and emergency services,  
97 all members of the workforce ceased working from Chinese Lunar New Year (January  
98 24th, 2020) and were required to return to work not before the date of February  
99 10th, 2020. The COVID-19 has shattered the daily routine, business, schools, lifestyle  
100 and economy of the globe.[2]

101 Recent studies showed that the COVID-19 pandemic is having a profound effect  
102 on all aspects of society, not only physical health but also mental health. A significant  
103 decrease in acute coronary syndrome (ACS) related hospitalization and  
104 out-of-patient rates were reported in Italy during the early days of the Covid-19  
105 outbreak.[3-4] Projected increases in suicide were found owing to COVID-19 in  
106 Canada.[5] A recent study in China found that the vicarious traumatization scores of  
107 the general public were significantly higher than those of the front-line nurses.[6]  
108 Different levels of psychological impacts including stress, anxiety and depression  
109 might be reasons for the increase suicide events in this period. Multidisciplinary  
110 research priorities for the COVID-19 pandemic is calling for an urgent.[7]

111 Guangdong province has 108 million permanent residents that account for  
112 8.03% of the population in China. Compared with other provinces, Guangdong has  
113 achieved the highest gross domestic product, and become the most leading  
114 developed province with the largest population in southern China. Currently, little is  
115 known about the mortality changes of injury including suicide in different age and  
116 sex group during COVID-19 period in southern China, even in Guangdong province.  
117 This might help provide evidence about the situation of injury and mental health

1  
2  
3  
4 118 problem at this scenario; guidance and actionable information for governments and  
5  
6 119 public health authorities at the pandemic period. To solve the gap, we conducted  
7  
8 120 this population-based retrospective study to ascertain the injury mortality changes  
9  
10 121 at the COVID-19 period in Guangdong, China.  
11  
12 122

## 123 **Methods and material**

### 124 **Study design and data source**

125 We conducted a population-based retrospective analysis to compare mortality  
126 changes of injury in different categories including transport injuries, poisonings, falls,  
127 fire/heat/hot substances, drowning, self-harm and interpersonal violence based on  
128 sex, age group between study and control period. The study period was defined as  
129 the time between first cases found and quarantine measure implemented in  
130 Guangdong (1st January 2020) and 30th June 2020, while the control period was  
131 defined as a corresponding period during the previous year (from 1st January 2019  
132 to 30th June 2019). Death registration in Guangdong province is an all-cause of  
133 death surveillance which covering the whole population living in Guangdong.  
134 Mortality data for this study was derived from Chinese Center for Disease Control  
135 and Prevention Cause of Death Reporting System.

### 136 **Definition of major injury category**

137 Injury deaths were identified according to the ICD-10 codes recommended by the US  
138 CDC,[8-9] based on the following diagnosis codes: V01-Y89. Based on published  
139 studies and ICD-10 codes of injury, we selected several categories of injury: transport  
140 injuries (V01-V04,V06,V09-V80,V87,V89,V99), poisonings (X40-X49), falls (W00-W19),  
141 fire, heat, and hot substances (X00-X09), drowning (W65-W74), self-harm  
142 (X60-X84,Y87.0) and interpersonal violence (X85-Y09,Y87.1).

### 143 **Statistical analyses**

144 The completeness of death surveillance in Guangdong was estimated using an  
145 empirical method reported by Adair T and Lopez AD.[10] Briefly, the following  
146 equation was using to predict completeness for both sexes:



$$\text{logit}(C^{All}) = (RegCDR_{sq} \times -0.0238) + (RegCDR \times 0.8419) + (\%65 \times -19.6118) + (\ln(5q0) \times -1.5135) + (Year \times -0.0251) + 44.3755 + \gamma$$

where  $C^{All}$  is the completeness of registration at all ages,  $\text{logit}(C^{All})$  is  $\ln\left(\frac{C^{All}}{1-C^{All}}\right)$ ,

$RegCDR$  is the registered crude death rate (CDR),  $RegCDR_{sq}$  is the square of  $RegCDR$ ,  $\%65$  is the fraction of the population aged 65 years and over,  $\ln(5q0)$  is the natural log of the under-5 mortality rate,  $Year$  is calendar year,  $\gamma$  is a random effect,

Predicted completeness is converted using the inverse logit:  $\frac{e^{\text{logit}(C^{All})}}{e^{\text{logit}(C^{All})} + 1}$

Because of the overdispersion of injury deaths, we used negative binomial models to explore the associations of deaths with socio-demographic factors including sex, age group, and duration.[11-12] All statistical analyses were conducted using Stata statistical software version 12.1. Differences were considered statistically significant in 2-tailed tests if p-values were less than 0.05.

## Results

The injury mortality in Guangdong province decreased significantly from 28.65 per 100000 people in 2019 control period to 23.24 per 100000 people in COVID-19 pandemic period ( $P < 0.05$ ). Likewise, mortality of lower injury categories including transport injuries (5.06 per 100000 people vs. 7.11 per 100000 people), poisonings (1.04 per 100000 people vs. 1.18 per 100000 people), falls (8.45 per 100000 people vs. 9.31 per 100000 people), fire, heat, and hot substances (0.17 per 100000 people vs. 0.24 per 100000 people), drowning (1.23 per 100000 people vs. 1.87 per 100000 people), self-harm (3.04 per 100000 people vs. 3.73 per 100000 people), interpersonal violence (0.16 per 100000 people vs. 0.29 per 100000 people) decreased significantly in COVID-19 pandemic period in 2020, when comparing with the control period in 2019. (**Table 1**)

174

175 **Table 1. Comparison of mortality for injury causes in Guangdong, China between**  
 176 **the Onset of the Covid-19 Outbreak and Control Period in 2019.**

| Injury subtypes                | Study period<br>(1/100000) | Control period<br>(1/100000) | Changes<br>(%) | <i>P</i>          |
|--------------------------------|----------------------------|------------------------------|----------------|-------------------|
| All cause of injury            | 23.24                      | 28.65                        | -18.86         | <i>P</i> < 0.0001 |
| Transport injuries             | 5.06                       | 7.11                         | -28.80         | <i>P</i> < 0.0001 |
| Poisonings                     | 1.04                       | 1.18                         | -11.71         | 0.028             |
| Falls                          | 8.45                       | 9.31                         | -9.30          | <i>P</i> < 0.0001 |
| Fire, heat, and hot substances | 0.17                       | 0.24                         | -28.41         | 0.012             |
| Drowning                       | 1.23                       | 1.87                         | -34.51         | <i>P</i> < 0.0001 |
| Self-harm                      | 3.04                       | 3.73                         | -18.46         | <i>P</i> < 0.0001 |
| Interpersonal violence         | 0.16                       | 0.29                         | -43.19         | <i>P</i> < 0.0001 |

177

178

179 Except for the increase death rate of Zhuhai (9.89%) and Qingyuan (0.52%),  
 180 death rate of all injuries in 11 cities decreased significantly in Guangdong during  
 181 COVID-19 period when comparing with control period in 2019. Mortality of transport  
 182 injuries in 17 cities in Guangdong declined significantly in COVID-19 period,  
 183 decreased rate falling from 11.82% people in Zhuhai to 71.26% in Shenzhen.  
 184 Decreased death rate from falls fell from -0.16% to -44.48% in 16 cities in Guangdong,  
 185 while mortalities increased from 0.07% to 28.28% in five cities including Guangzhou,  
 186 Zhuhai, Heyuan, Qingyuan and Zhongshan. Self-harm mortality increased from 4.12%  
 187 to 24.71% in Zhuhai, Zhaoqing, Meizhou, Yangjiang, Zhongshan and Jieyang in  
 188 COVID-19 period, while reduced self-harm mortalities were reported in other cities.

189 **(E-Table 1, Figure 1)**

190 Mortalities from all and other lower category injuries including transport  
 191 injuries, falls, fire, heat, and hot substances, drowning, self-harm and interpersonal  
 192 violence decreased significantly in total male and female population, except for heat,  
 193 and hot substances in female (**Table 2, Figure 2**). Mortality from drowning declined  
 194 from 0.44% to 55.27% in all age-sex groups. Interestingly, when dividing the

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

195 population into different age groups, some statistical significant increased  
196 mortalities could be observed. We noted that self-harm mortality in 0-14 age group  
197 had statistical significant increase in male/female/ general population. Even though,  
198 self-harm, transport injury, falls, interpersonal violence mortality changes in 70-79  
199 age group did not yielded a statistical significance, while the increases of this age  
200 group in different sex population were noteworthy. Likewise, there were  
201 insignificant increases of mortality from fire, heat, and hot substances in 80+ age  
202 group in all sex population and falls in 80+ age group in male. (Table 2, Figure 3-4)

203

204

205 **Table2. Mortality changes for injury causes in Guangdong, China between the**  
206 **Covid-19 Outbreak and Control Period in 2019 in different age groups in male and**  
207 **female population.**

| Sex group          | Age group | Transport injuries | Poisonings | Falls   | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All-cause of injury |
|--------------------|-----------|--------------------|------------|---------|--------------------------------|----------|-----------|------------------------|---------------------|
| Male               | 0-14      | -32.25*            | -39.30     | -13.19  | -69.83*                        | -19.32   | 139.71*   | 56.90                  | -22.50*             |
|                    | 15-59     | -31.56*            | -10.15     | -16.89* | -48.01*                        | -32.84*  | -24.25*   | -55.36*                | -25.99*             |
|                    | 60-69     | -35.86*            | 3.30       | -27.63* | -42.45                         | -45.88*  | -19.98    | -35.54                 | -29.49*             |
|                    | 70-79     | 7.44               | -0.94      | 6.75    | -40.91                         | -41.31*  | 21.41     | 87.11                  | 2.71                |
|                    | 80+       | -13.68             | -6.54      | 5.45    | 32.16                          | -15.04   | -43.68*   | 3.84                   | 0.53                |
|                    | Total     | -27.06*            | -9.16      | -8.72*  | -39.99*                        | -30.90*  | -20.19*   | -40.54*                | -19.56*             |
| Female             | 0-14      | -36.34*            | -35.24     | -8.50   | -6.46                          | -55.27*  | 115.13*   | -48.98                 | -37.04*             |
|                    | 15-59     | -36.42*            | -20.97     | -10.48  | -36.32                         | -41.98*  | -19.51*   | -47.01*                | -26.13*             |
|                    | 60-69     | -43.33*            | -14.22     | -21.81  | 51.38                          | -50.51*  | -35.40*   | -52.69                 | -35.63*             |
|                    | 70-79     | -2.53              | -22.83     | 3.49    | 49.58                          | -0.44    | 12.40     | -28.77                 | 2.51                |
|                    | 80+       | -33.09*            | 101.69     | -6.87*  | 31.10                          | -42.37*  | 0.85      | 0.85                   | -6.86*              |
|                    | Total     | -32.78*            | -16.62     | -9.93*  | -1.21                          | -40.67*  | -15.17*   | -46.06*                | -17.58*             |
| General population | 0-14      | -34.07*            | -36.68*    | -11.18  | -52.00                         | -31.89*  | 127.36*   | -16.00                 | -28.87*             |
|                    | 15-59     | -32.71*            | -13.13*    | -15.56* | -44.10*                        | -35.25*  | -22.67*   | -51.68*                | -25.99*             |
|                    | 60-69     | -38.81*            | -3.04      | -27.01* | -31.62                         | -48.12*  | -27.24*   | -45.90                 | -32.22*             |
|                    | 70-79     | 3.32               | -12.44     | 4.92    | -22.48                         | -20.40   | 16.83     | 27.69                  | 2.12                |
|                    | 80+       | -21.92             | 29.26      | -2.45   | 31.20                          | -33.03*  | -22.78    | 2.05                   | -4.04               |
|                    | Total     | -28.80*            | -11.71*    | -9.30*  | -28.41*                        | -34.51*  | -18.46*   | -43.19*                | -18.86*             |

208 \*: statistical significance using Poisson regression model for comparison of COVID-19 period and control period  
209 in 2019 (P< 0.05)

210

## 211 Discussion

212 It seemed mortality from all injury and other lower category injury including

1  
2  
3  
4 213 transport injuries, poisonings, falls, fire/heat/hot substances, drowning, self-harm  
5  
6 214 and interpersonal violence decreased and benefited from the COVID-19 pandemic.  
7  
8 215 However, when dividing the population into different city, age and sex groups, some  
9  
10 216 statistical significant increased mortalities could be found in specific injury categories.  
11  
12 217 Though mortality changes in some groups did not have statistical significances,  
13  
14 218 increased mortalities were noteworthy, i.e. self-harm, transport injury, falls,  
15  
16 219 interpersonal violence in 70-79 age group. This provide a priorities and longer-term  
17  
18 220 strategies for injury and mental health science research, control and prevention.  
19  
20 221 Based on our best knowledge, this is the first study that conducted to demonstrate  
21  
22 222 multiple injury mortality at different age and sex population at provincial level in  
23  
24 223 China, making comparisons between COVID-19 pandemic period and control period  
25  
26 224 in 2019.

27 225 We have make big progress in improvements in road construction, expansion of  
28  
29 226 road safety awareness, increased motor vehicle safety systems and establishment in  
30  
31 227 road safety laws, annual drownings warnings from Ministry of Education, improved  
32  
33 228 infrastructure projects to decrease exposure to bodies of water during these years.  
34  
35 229 This might contribute in decreasing in transport injury [13] and drowning [14-15]  
36  
37 230 mortality. As this study conducted at the time when China was facing the COVID-19  
38  
39 231 pandemic and imposed lockdown and quarantine measures, the full impact of  
40  
41 232 COVID-19 on injury at its peak would be captured. During the COVID-19 outbreak  
42  
43 233 and the outcomes of isolation and quarantine, most people were avoiding going out  
44  
45 234 to reduce the chance of infecting with COVID-19 virus. As a result, there were sharp  
46  
47 235 decreased mortalities from transport injury and drowning at all age from different  
48  
49 236 population across 20 cities from Guangdong, except for Chaozhou and male  
50  
51 237 population aging from 70 to 79 years old.

52 238 In line with our study, several researchers demonstrated that there is a  
53  
54 239 correlation between age and mortality following fire, heat, and hot substances with  
55  
56 240 elderly patients usually bearing a higher mortality.[16-17] Different from previous  
57  
58 241 study, scalds were accounted for 60% of deaths of injury in >75 years age group in  
59  
60 242 UK,[18] yet fire or smoke inhalation is the main cause resulting to the main death of

1  
2  
3  
4 243 fire, heat, and hot substances among elderly in Guangdong. A comprehensive fire,  
5  
6 244 heat, and hot substances reduction strategy in the elderly is still lacking.  
7  
8 245 Comprehensive strategy employing public education, distribution of firefighting  
9  
10 246 equipment, adequate supervision for vulnerable adults while heating and cooking as  
11  
12 247 well as the use of aging electric appliance to prevent fire, heat, and hot substances  
13  
14 248 injury in the elderly warrants development and evaluation.

15  
16 249 The death rate of falls declined overall for decades of years, yet with a notable  
17  
18 250 increase in older people. This is probably due to the increased life expectancy in the  
19  
20 251 past two decades. Greater proportion of older people living with chronic diseases  
21  
22 252 were at risk of falls.[19] The problem is going to worsen among elderly during  
23  
24 253 COVID-19 period, since elderly subjects remain exposed to trauma due to domestic  
25  
26 254 falls with reduced number of health services.[20] In this case, older population were  
27  
28 255 suffering from a higher risk of disability or death due to delayed care and treatment  
29  
30 256 for fall-related injuries.[21-22] Given the relative high burden of falls among elderly,  
31  
32 257 systematic implementation for reducing injuries from falls was needed including  
33  
34 258 sufficient medical and occupational-therapy,[23] professional environment hazard  
35  
36 259 assessment and modification,[24] vitamin D and calcium supplementation, hip  
37  
38 260 protectors, reduction of many of the predisposing and situational risk factors.[25]

39  
40 261 Self-harm is becoming a more pressing concern as the pandemic spreads and  
41  
42 262 has longer-term effects on the general population, the economy, and vulnerable  
43  
44 263 groups. There is some evidence that deaths by suicide increased in the USA during  
45  
46 264 the 1918–19 influenza pandemic [26] and among older people in Hong Kong during  
47  
48 265 the 2003 severe acute respiratory syndrome (SARS) epidemic.[27] The infectious  
49  
50 266 disease epidemics seemed to serve as a catalyst to trigger the suicidal thought of  
51  
52 267 people with mental health problems. As shown by our results, increased death rate  
53  
54 268 for self-harm was observed at the age of 0-14 and 70-79 in both sex. The likely  
55  
56 269 adverse effects of the pandemic on population mental health, might be exacerbated  
57  
58 270 by fear, self-isolation and physical distancing,[28] contributing to an increase in the  
59  
60 271 prevalence of PTSD symptoms, depression, anxiety and stress in general population  
272 in China during the COVID-19 outbreak.[29] Together with the extraordinary high

1  
2  
3  
4 273 case fatality rate for those elderly patients,[30] older adults and people with mental  
5  
6 274 health problems became even more worried. A higher risk of being exposed to  
7  
8 275 family conflicts, physical and/or sexual violence at home and economic damage  
9  
10 276 caused by the COVID-19 crisis may lead to increased suicide rates among  
11  
12 277 children.[31] Loss of employment and financial stressors are also well-recognized risk  
13  
14 278 factors for suicide. [32] Selective and universal interventions are required for  
15  
16 279 targeted individuals at heightened risk of suicide, including making evidence-based  
17  
18 280 online interventions freely available, increasing volunteer workforce for crisis  
19  
20 281 hotlines, providing financial safety nets for unemployment support.[33] In addition,  
21  
22 282 domestic violence and alcohol consumption might increase during lockdown. Public  
23  
24 283 health responses must ensure that those facing interpersonal violence are supported  
25  
26 284 and that safe drinking messages are communicated, particularly for bereaved  
27  
28 285 individuals. Accessible health education and promotion for COVID-19 is  
29  
30 286 recommended, regarding that the extent that people proactively engaged in hand  
31  
32 287 hygiene could decrease the likelihood that the workforce experience psychiatric  
33  
34 288 symptoms.[29,34]

35 289 One of the main limitations of measuring injury burden in Guangdong during  
36  
37 290 COVID-19 period was a lack of reliable injury incidence data. Second, we need to be  
38  
39 291 a bit more cautious about the causative effect of the COVID-19 epidemic on injury  
40  
41 292 mortality, owing to the limitation of the observational study. Despite the limitations,  
42  
43 293 this study are still considered to be robust. Death registration in Guangdong province  
44  
45 294 is an all-cause of death surveillance which covering all the population living in  
46  
47 295 Guangdong. Data from the registration system in recent years aligned well with the  
48  
49 296 vital registration data that achieved large increases in coverage over the past  
50  
51 297 decade.[35] Moreover, we have used the empirical method to avoid  
52  
53 298 underestimation in death surveillance.

54 299 In conclusion, the COVID-19 pandemic was associated with decreased mortality of  
55  
56 300 all injury, transport injury and drowning. However, increased mortality of falls, fire,  
57  
58 301 heat, and hot substances injury, self-harm in specific age population during the  
59  
60 302 COVID-19 period, warrant selective, indicated and universal interventions for public.

1  
2  
3  
4 303

5  
6 304

7 305 **Acknowledgements:** None.

9 306 **Contributors:** Xue-yan Zheng<sup>1#</sup>, Si-li Tang<sup>1,2#</sup>, Shu-li Ma<sup>1,3#</sup>, Xiao-jun Xu<sup>1</sup>, Hao-feng  
11 307 **Xu, Ying-shan Xu<sup>1</sup>, Yan-jun Xu<sup>1\*</sup>, Li-feng Lin**

13 308 Xiao-jun Xu, Hao-feng Xu, Ying-shan Xu, Yan-jun Xu and Li-feng Lin conceived of the  
15 309 study and provided overall guidance. Xue-yan Zheng, Si-li Tang, Shu-li Ma, Wei-jie  
17 310 Guan and Li-feng Lin prepared the first draft and finalized the manuscript based on  
19 311 comments from all other authors and reviewer feedback. Xue-yan Zheng, Wei-jie  
21 312 Guan, Yan-jun Xu and Li-feng Lin played a key role in formulating the analysis. All  
23 313 other authors contributed to the analysis and reviewed the manuscript.

25 314 **Funding:** This research received no specific grant from any funding agency in the  
27 315 public, commercial or not-for-profit sectors.

29 316

31 317 **Competing interests:**

33 318 We declare no competing interests.

35 319

37 320

39 321 **Reference:**

41 322 1. Hao F, Tan W, Jiang L, et al. Do psychiatric patients experience more psychiatric  
43 323 symptoms during COVID-19 pandemic and lockdown? A case-control study with  
45 324 service and research implications for immunopsychiatry. *Brain Behav Immun.*  
47 325 2020;87:100-106.

49 326 2. Gautam R, Sharma M. 2019-nCoV pandemic: A disruptive and stressful  
51 327 atmosphere for Indian academic fraternity. *Brain Behav Immun.* 2020;88:948-949.  
53 328 doi:10.1016/j.bbi.2020.04.025.

55 329 3. Baldi E, Sechi GM, Mare C, et al. Out-of-Hospital Cardiac Arrest during the  
57 330 Covid-19 Outbreak in Italy. *N Engl J Med.* 2020;383(5):496-498.

59 331 4. De Filippo O, D'Ascenzo F, Angelini F, et al. Reduced Rate of Hospital Admissions  
61 332 for ACS during Covid-19 Outbreak in Northern Italy. *N Engl J Med.* 2020;383(1):88-89.

- 1  
2  
3  
4 333 5. McIntyre RS, Lee Y. Projected increases in suicide in Canada as a consequence of  
5 334 COVID-19. *Psychiatry Res.* 2020;290:113104.
- 6  
7 335 6. Li Z, Ge J, Yang M, et al. Vicarious traumatization in the general public, members,  
8 336 and non-members of medical teams aiding in COVID-19 control. *Brain Behav Immun.*  
9 337 2020;88:916-919.
- 10  
11 338 7. Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for  
12 339 the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry.*  
13 340 2020;7(6):547-560.
- 14  
15 341 8. Faul M, Xu L, Wald MM, Coronado VG. Traumatic brain injury in the United States:  
16 342 emergency department visits, hospitalizations and deaths 2002–2006. Atlanta: US  
17 343 Centers for Disease Control and Prevention; 2010.
- 18  
19 344 9. Thurman DJ, Sniezek JE, Johnson D, Greenspan A, Smith SM. Guidelines for  
20 345 surveillance of central nervous system injury. Washington (DC): US Department of  
21 346 Health and Human Services; 1995.
- 22  
23 347 10. Adair T, Lopez AD. Estimating the completeness of death registration: An  
24 348 empirical method. *PLoS One.* 2018; 13(5):e0197047.
- 25  
26 349 11. Adams RS, Larson MJ, Corrigan JD, Ritter GA, Williams TV. Traumatic brain injury  
27 350 among U.S. active duty military personnel and negative drinking-related  
28 351 consequences. *Subst Use Misuse.* 2013; 48:821-36.
- 29  
30 352 12. Statistical Consulting Group. Negative binomial regression: Stata annotated  
31 353 output. Available from:  
32 354 <https://stats.idre.ucla.edu/stata/output/negative-binomial-regression/>. Accessed  
33 355 2017 Jun 1.
- 34  
35 356 13. Leilei D, Pengpeng Y, Haagsma JA, et al. The burden of injury in China, 1990-2017:  
36 357 findings from the Global Burden of Disease Study 2017. *Lancet Public Health.*  
37 358 2019;4(9):e449-e461.
- 38  
39 359 14. Ministry of Education of the People's Republic of China. The education status of  
40 360 China in 2013.  
41 361 [http://www.moe.gov.cn/jyb\\_sjzl/s5990/201503/t20150331\\_186797.html](http://www.moe.gov.cn/jyb_sjzl/s5990/201503/t20150331_186797.html) (accessed  
42 362 June 13, 2018;in Chinese).



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

- 363 15. The Central People's Government of the People's Republic of China. Circular of  
364 the State Council on printing and distributing the outline of the development of  
365 Chinese women and the program for the development of children in China.  
366 [http://www.gov.cn/gongbao/content/2011/content\\_1927200.htm](http://www.gov.cn/gongbao/content/2011/content_1927200.htm)(accessed June 13,  
367 2018; in Chinese).
- 368 16. Sadeghian F, Saeedi Moghaddam S, Saadat S, et al. The trend of burn mortality in  
369 Iran - A study of fire, heat and hot substance-related fatal injuries from 1990 to 2015.  
370 *Burns*. 2019;45(1):228-240.
- 371 17. Tang K, Jian L, Qin Z, Zhenjiang L, Gomez M, Beveridge M. Characteristics of burn  
372 patients at a major burn center in Shanghai. *Burns* 2006;32: 1037-43.
- 373 18. Hussain A, Dunn K. Burn related mortality in Greater Manchester: 11-year review  
374 of Regional Coronial Department Data. *Burns*. 2015;41(2):225-234.
- 375 19 Centers for Disease Control and Prevention. Fatalities and injuries from falls  
376 among older adults, United States, 1993–2003 and 2001–2005. *MMWR Morb Mortal*  
377 *Wkly Rep* 2006; 55: 1221–24.
- 378 20. Gumina S, Proietti R, Polizzotti G, Carbone S, Candela V. The impact of COVID-19  
379 on shoulder and elbow trauma: an Italian survey [published online ahead of print,  
380 2020 May 20]. *J Shoulder Elbow Surg*. 2020; S1058-2746(20)30401-8.
- 381 21. Tong HJ, Huang CY. Changes of family structure and their social influence in  
382 contemporary China. *Xi Bei Ren Kou Za Zhi* 2015; 6: 81–84 (in Chinese).
- 383 22. Gao M, Li Y, Zhang S, et al. Does an empty nest affect elders' health? Empirical  
384 evidence from China. *Int J Environ Res Public Health* 2017; 14: E463.
- 385 23. Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in  
386 the elderly trial (PROFET): a randomised controlled trial. *Lancet*. 1999;  
387 353(9147):93-97.
- 388 24. Keall MD, Pierse N, Howden-Chapman P, et al. Home modifications to reduce  
389 injuries from falls in the home injury prevention intervention (HIPI) study: a  
390 cluster-randomised controlled trial. *Lancet*. 2015;385(9964):231-238.
- 391 25. Kannus P, Sievänen H, Palvanen M, Järvinen T, Parkkari J. Prevention of falls and  
392 consequent injuries in elderly people. *Lancet*. 2005; 366(9500):1885-1893.

- 1  
2  
3  
4 393 26. Wasserman IM. The impact of epidemic, war, prohibition and media on suicide:  
5 394 United States, 1910–1920. *Suicide Life Threat Behav* 1992; 22: 240–54.
- 6  
7 395 27. Cheung YT, Chau PH, Yip PS. A revisit on older adults suicides and severe acute  
8 396 respiratory syndrome (SARS) epidemic in Hong Kong. *Int J Geriatr Psychiatry* 2008; 23:  
9 397 1231–38.
- 10  
11  
12  
13 398 28. Yao H, Chen JH, Xu YF. Patients with mental health disorders in the COVID-19  
14 399 epidemic. *Lancet Psychiatry* 2020; 7: e21
- 15  
16  
17 400 29. Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general  
18 401 population during the COVID-19 epidemic in China. *Brain Behav Immun.*  
19 402 2020;87:40-48.
- 20  
21  
22  
23 403 30. Guan WJ, Liang WH, Zhao Y, et al. Comorbidity and its impact on 1590 patients  
24 404 with COVID-19 in China: a nationwide analysis. *Eur Respir J.* 2020;55(5):2000547.
- 25  
26  
27 405 31. Hoekstra PJ. Suicidality in children and adolescents: lessons to be learned from  
28 406 the COVID-19 crisis. *Eur Child Adolesc Psychiatry.* 2020;29(6):737-738.
- 29  
30  
31 407 32. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of  
32 408 economic crises and alternative policy responses in Europe: an empirical analysis.  
33 409 *Lancet* 2009; 374: 315-23.
- 34  
35  
36 410 33. Gunnell D, Appleby L, Arensman E, et al. Suicide risk and prevention during the  
37 411 COVID-19 pandemic. *Lancet Psychiatry.* 2020;7(6):468-471.
- 38  
39  
40 412 34. Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19  
41 413 pandemic stressful? A study on immediate mental health status and  
42 414 psychoneuroimmunity prevention measures of Chinese workforce. *Brain Behav*  
43 415 *Immun.* 2020;87:84-92.
- 44  
45  
46  
47 416 35 . GBD 2017 Mortality Collaborators. Global, regional, and national age- and  
48 417 sex-specific mortality and life expectancy for 195 countries and territories,  
49 418 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017.  
50 419 *Lancet* 2018;392: 1684–735.
- 51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

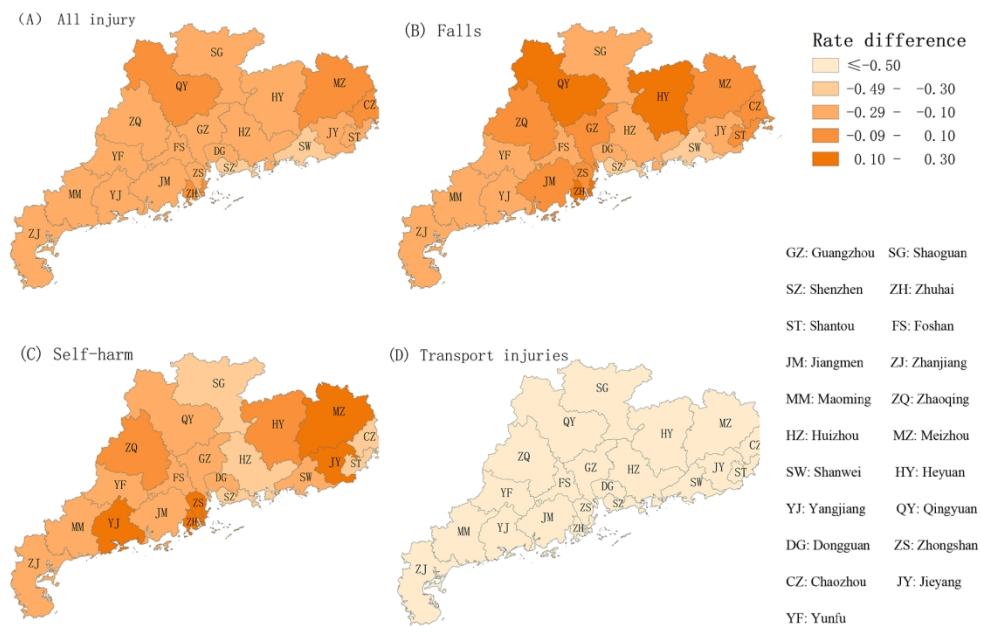


Figure 1. All injury, transport injuries, falls and self-harm mortality changes between the Covid-19 pandemic period and control period in 21 cities in Guangdong province, China.

160x119mm (300 x 300 DPI)

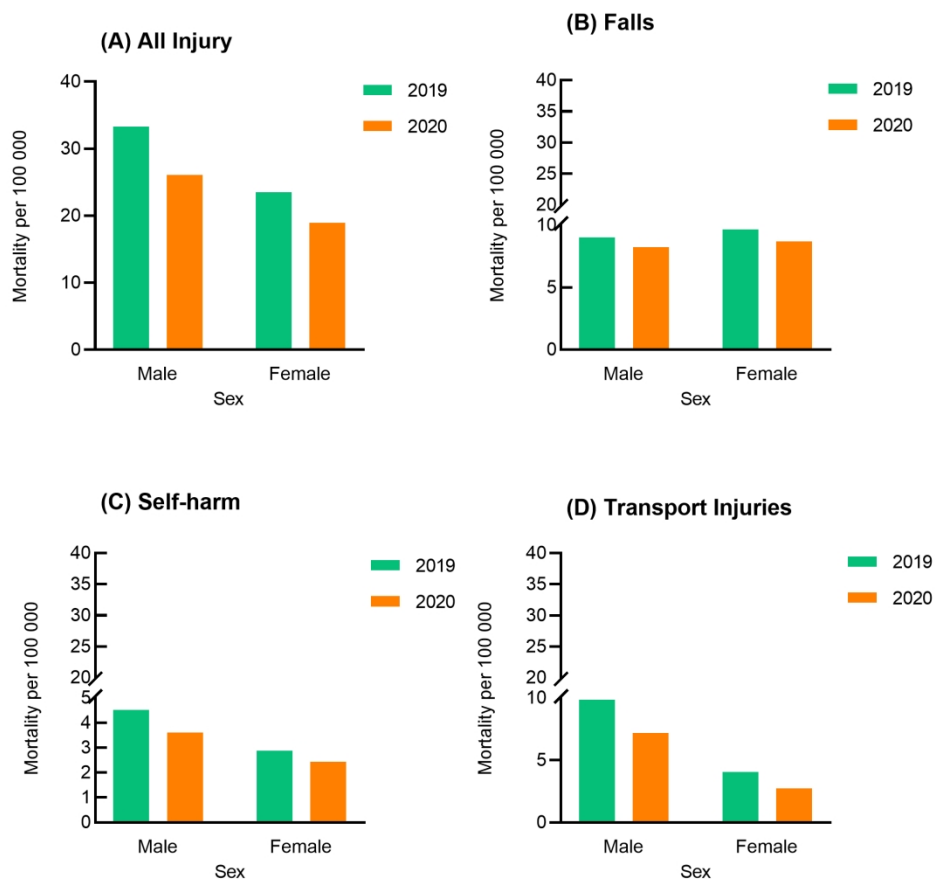


Figure 2. All injury, transport injuries, falls and self-harm in different sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

191x181mm (300 x 300 DPI)

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

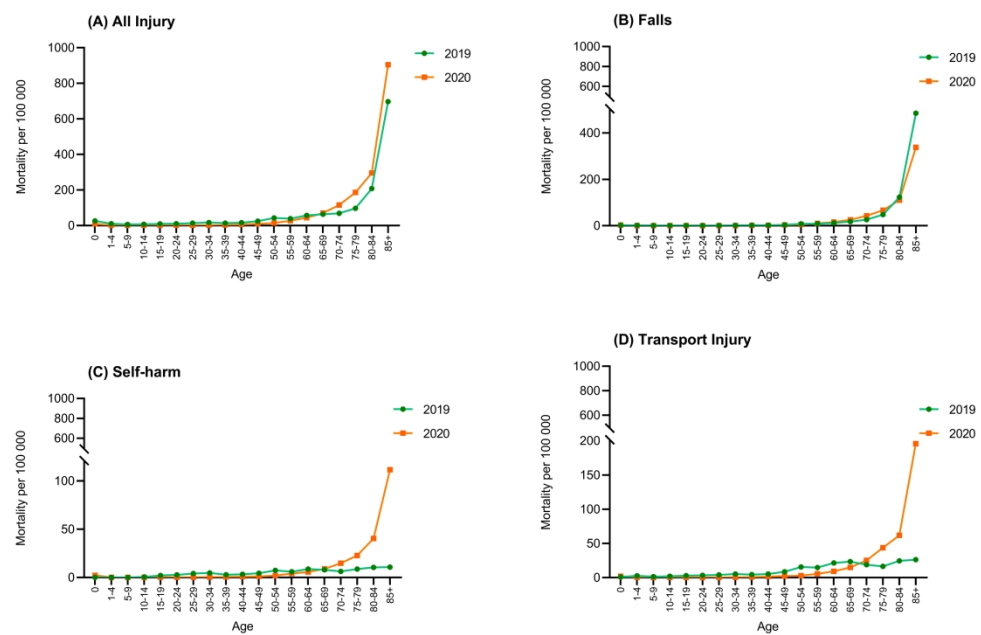


Figure 3. All injury, transport injuries, falls and self-harm mortality in different age groups between the Covid-19 pandemic period and control period in Guangdong province, China.

155x111mm (600 x 600 DPI)

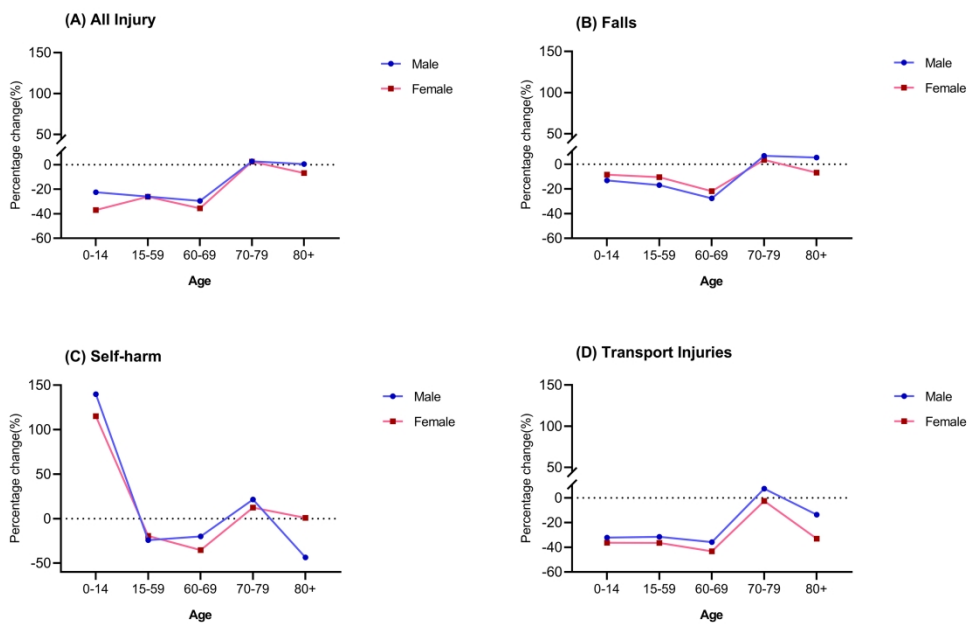



Figure 4. All injury, transport injuries, falls and self-harm mortality changes in different age and sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

155x112mm (600 x 600 DPI)

**E-Table 1. Mortality changes for injury causes in 21 cities of Guangdong, China between the Covid-19 Outbreak and Control Period in 2019.**

|           | Transport injuries | Poisonings | Falls   | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All injury |
|-----------|--------------------|------------|---------|--------------------------------|----------|-----------|------------------------|------------|
| Guangzhou | -24.44*            | -34.69*    | 3.04    | -52.10                         | -15.31   | -27.80*   | -32.59                 | -15.91*    |
| Shaoguan  | -21.59*            | -15.56     | -23.96* | -80.43                         | -36.08*  | -37.32*   | -75.53                 | -26.99*    |
| Shenzhen  | -71.26*            | -44.48     | -44.48* | -100.00                        | -65.11*  | -33.23*   | -66.85*                | -43.55*    |
| Zhuhai    | -11.82             | 83.86      | 28.28   | -                              | -2.32    | 15.91     | -38.71                 | 9.89       |
| Shantou   | -29.92*            | -7.49      | -5.40   | -58.02                         | 95.90    | -34.19*   | 95.90                  | -11.01     |
| Foshan    | -23.01*            | -4.62      | -15.05* | -18.25                         | -43.97*  | -13.04    | -68.21                 | -21.80*    |
| Jiangmen  | -7.92              | -38.49     | -3.97   | 193.09                         | -46.10*  | -17.50    | -30.22                 | -13.05*    |
| Zhanjiang | -25.31*            | -18.24     | -22.99* | 76.61                          | -19.29   | -19.58    | -75.47                 | -25.13*    |
| Maoming   | -29.77*            | -26.58     | -16.27  | -44.70                         | -35.09*  | -15.96    | 45.16                  | -27.33*    |
| Zhaoqing  | -40.75*            | -47.01*    | -1.19   | -21.91                         | -52.77*  | 4.12      | 13.88                  | -17.90*    |
| Huizhou   | -44.99*            | -16.52     | -12.96  | -26.95                         | -43.06*  | -45.78*   | -51.30                 | -28.22*    |
| Meizhou   | -21.70*            | 63.96*     | -5.19   | 47.57                          | 2.09     | 21.19     | -83.60                 | -1.38      |
| Shanwei   | -56.72*            | -2.05      | -35.39  | -100.00*                       | -21.64   | -19.54    | -100.00                | -42.23*    |
| Heyuan    | -29.16*            | 1.28       | 15.00   | 31.18                          | -45.34   | -3.95     | -                      | -11.26     |
| Yangjiang | -33.28*            | 128.64*    | -21.33  | 95.98                          | 11.35    | 24.71     | -2.01                  | -19.12*    |
| Qingyuan  | -9.59              | 39.44      | 17.42*  | -50.94                         | -40.57*  | -15.70    | -1.88                  | 0.52       |

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

|           |         |         |         |         |         |         |   |         |
|-----------|---------|---------|---------|---------|---------|---------|---|---------|
| Dongguan  | -11.10  | -43.32* | -17.44* | -34.74  | -54.71* | -15.758 | -61.54*   | -17.90* |
| Zhongshan | -40.26* | -45.44* | 0.07    | -78.45* | -36.45  | 24.70   | -75.75  | -18.59* |
| Chaozhou  | 6.93    | -1.74   | -0.16   | -26.30  | -45.96  | -33.53  |  | -4.66   |
| Jieyang   | -35.11* | 14.83   | -27.02* | -26.18  | -18.55  | 23.03   | -1.58   | -17.69* |
| Yunfu     | -41.93* | 14.87   | -16.59  | 13.91   | -73.15* | -22.80  | 144.10  | -26.19* |
| Guangdong | -28.80* | -11.71* | -9.30*  | -28.41* | -34.51* | -18.46* | -43.19*   | -18.86* |

---



E-Table 2. Mortality for injury causes in Guangdong, China between the Covid-19 Outbreak and Control Period in 2019 in different age groups in male and female population.

| Sex group                       | Age group | Transport injuries | Poisonings | Falls  | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All-cause of injury |
|---------------------------------|-----------|--------------------|------------|--------|--------------------------------|----------|-----------|------------------------|---------------------|
| <b>Control Period in 2019</b>   |           |                    |            |        |                                |          |           |                        |                     |
| Male                            | 0-14      | 2.12               | 0.41       | 1.18   | 0.25                           | 2.72     | 0.17      | 0.1                    | 9.57                |
|                                 | 15-59     | 8.7                | 1.69       | 3.75   | 0.17                           | 1.82     | 4.89      | 0.33                   | 25.35               |
|                                 | 60-69     | 31.36              | 2.42       | 20.74  | 0.87                           | 4.16     | 9         | 0.31                   | 79.04               |
|                                 | 70-79     | 25.61              | 1.56       | 41.12  | 1.74                           | 4.04     | 7.89      | 0.28                   | 98.13               |
|                                 | 80+       | 37.36              | 4.67       | 225.8  | 2.57                           | 7.71     | 13.78     | 0.7                    | 359.13              |
|                                 | Total     | 9.87               | 1.54       | 9.02   | 0.32                           | 2.29     | 4.51      | 0.29                   | 33.33               |
| Female                          | 0-14      | 1.74               | 0.63       | 1.11   | 0.12                           | 1.66     | 0.24      | 0.27                   | 8.71                |
|                                 | 15-59     | 3.08               | 0.72       | 1.02   | 0.09                           | 0.73     | 2.63      | 0.28                   | 9.57                |
|                                 | 60-69     | 12.77              | 1          | 8.09   | 0.13                           | 3.48     | 7.75      | 0.53                   | 38.9                |
|                                 | 70-79     | 10.13              | 1.6        | 31.11  | 0.44                           | 3.91     | 6.84      | 0.27                   | 65.77               |
|                                 | 80+       | 16.73              | 1.61       | 285.89 | 1.61                           | 10.14    | 8.37      | 0.16                   | 418.94              |
|                                 | Total     | 4.06               | 0.78       | 9.64   | 0.15                           | 1.41     | 2.87      | 0.29                   | 23.47               |
| General population              | 0-14      | 1.95               | 0.5        | 1.15   | 0.19                           | 2.25     | 0.2       | 0.17                   | 9.19                |
|                                 | 15-59     | 6.02               | 1.23       | 2.45   | 0.13                           | 1.3      | 3.81      | 0.31                   | 17.82               |
|                                 | 60-69     | 22.41              | 1.74       | 14.65  | 0.52                           | 3.83     | 8.4       | 0.42                   | 59.71               |
|                                 | 70-79     | 17.75              | 1.58       | 36.03  | 1.08                           | 3.97     | 7.36      | 0.27                   | 81.69               |
|                                 | 80+       | 25.15              | 2.86       | 261.38 | 2                              | 9.14     | 10.57     | 0.38                   | 394.54              |
|                                 | Total     | 7.11               | 1.18       | 9.31   | 0.24                           | 1.87     | 3.73      | 0.29                   | 28.65               |
| <b>Covid-19 Outbreak period</b> |           |                    |            |        |                                |          |           |                        |                     |

|                    |       |       |      |        |      |      |      |      |        |
|--------------------|-------|-------|------|--------|------|------|------|------|--------|
| Male               | 0-14  | 1.44  | 0.25 | 1.02   | 0.08 | 2.2  | 0.42 | 0.15 | 7.42   |
|                    | 15-59 | 5.96  | 1.52 | 3.12   | 0.09 | 1.22 | 3.7  | 0.15 | 18.76  |
|                    | 60-69 | 20.11 | 2.5  | 15.01  | 0.5  | 2.25 | 7.2  | 0.2  | 55.74  |
|                    | 70-79 | 27.52 | 1.55 | 43.9   | 1.03 | 2.37 | 9.58 | 0.52 | 100.79 |
|                    | 80+   | 32.25 | 4.36 | 238.11 | 3.39 | 6.55 | 7.76 | 0.73 | 361.04 |
|                    | Total | 7.2   | 1.4  | 8.23   | 0.19 | 1.58 | 3.6  | 0.17 | 26.81  |
| Female             | 0-14  | 1.11  | 0.41 | 1.02   | 0.11 | 0.74 | 0.52 | 0.14 | 5.48   |
|                    | 15-59 | 1.96  | 0.57 | 0.92   | 0.06 | 0.42 | 2.12 | 0.15 | 7.07   |
|                    | 60-69 | 7.24  | 0.86 | 6.32   | 0.2  | 1.72 | 5.01 | 0.25 | 25.05  |
|                    | 70-79 | 9.88  | 1.23 | 32.19  | 0.66 | 3.89 | 7.69 | 0.19 | 67.42  |
|                    | 80+   | 11.19 | 3.24 | 266.24 | 2.11 | 5.84 | 8.44 | 0.16 | 390.2  |
|                    | Total | 2.73  | 0.65 | 8.68   | 0.15 | 0.83 | 2.43 | 0.16 | 19.35  |
| General population | 0-14  | 1.29  | 0.32 | 1.02   | 0.09 | 1.53 | 0.46 | 0.14 | 6.54   |
|                    | 15-59 | 4.05  | 1.07 | 2.07   | 0.07 | 0.84 | 2.95 | 0.15 | 13.19  |
|                    | 60-69 | 13.71 | 1.69 | 10.69  | 0.35 | 1.99 | 6.11 | 0.23 | 40.48  |
|                    | 70-79 | 18.34 | 1.38 | 37.81  | 0.84 | 3.16 | 8.6  | 0.35 | 83.42  |
|                    | 80+   | 19.63 | 3.69 | 254.96 | 2.62 | 6.12 | 8.17 | 0.39 | 378.6  |
|                    | Total | 5.06  | 1.04 | 8.45   | 0.17 | 1.23 | 3.04 | 0.16 | 23.24  |

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

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

|                          |    |  |       |
|--------------------------|----|--|-------|
|                          |    | (b) Report category boundaries when continuous variables were categorized  | 7-8   |
|                          |    | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | 8     |
| Other analyses           | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | 8     |
| <b>Discussion</b>        |    |  |       |
| Key results              | 18 | Summarise key results with reference to study objectives   | 8-11  |
| Limitations              | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias                 | 11    |
| Interpretation           | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 10-11 |
| Generalisability         | 21 | Discuss the generalisability (external validity) of the study results  | 11    |
| <b>Other information</b> |    |  |       |
| Funding                  | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based              |       |

\*Give information separately for exposed and unexposed groups.

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

# BMJ Open

## Trends of injury mortality during the COVID-19 period in Guangdong, China: A population-based retrospective analysis

|                                 |   |
|---------------------------------|---|
| Journal:                        | <i>BMJ Open</i>   |
| Manuscript ID                   | bmjopen-2020-045317.R1  |
| Article Type:                   | Original research   |
| Date Submitted by the Author:   | 08-Dec-2020   |
| Complete List of Authors:       | Zheng, Xue-yan; Guangdong Center for Disease Control and Prevention, Institute of Non-communicable disease control and prevention;<br>Tang, Si-li; Southern Medical University, School of Public Health<br>Ma, Shu-li; Guangdong Pharmaceutical University, School of Public Health<br>Guan, Wei-jie; First Affiliated Hospital of Guangzhou Medical College, State Key Laboratory of Respiratory Disease and National Clinical Research Center for Respiratory Disease<br>Xu, Xiaojun; Guangdong Center for Disease Control and Prevention, Institute of Control and Prevention for Chronic Non-infective Disease<br>Xu, Haofeng; Guangdong Center for Disease Control and Prevention, Institute of Control and Prevention for Chronic Non-infective Disease<br>Xu, Ying-shan; Guangdong Center for Disease Control and Prevention, Institute of Control and Prevention for Chronic Non-infective Disease<br>Xu, Yan-jun; Guangdong Center for Disease Control and Prevention<br>Lin, Li-feng; Guangdong Center for Disease Control and Prevention |
| <b>Primary Subject Heading</b>: | Epidemiology  |
| Secondary Subject Heading:      | Public health   |
| Keywords:                       | EPIDEMIOLOGY, PUBLIC HEALTH, Suicide & self-harm < PSYCHIATRY   |
|                                 |   |

SCHOLARONE™  
Manuscripts



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

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

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

## Trends of injury mortality during the COVID-19 period in Guangdong,

### China: A population-based retrospective analysis

Xue-yan Zheng<sup>1#</sup>, Si-li Tang<sup>1,2#</sup>, Shu-li Ma<sup>1,3#</sup>, Wei-jie Guan<sup>4#</sup>, Xiao-jun Xu<sup>1</sup>, Hao-feng Xu<sup>1</sup>, Ying-shan Xu<sup>1</sup>, Yan-jun Xu<sup>1\*</sup>, Li-feng Lin<sup>1,2\*</sup>

1 Guangdong provincial center for disease control and prevention, Guangdong, China.

2 School of Public Health, Southern Medical University, Guangdong, China

3 Department of Epidemiology and Biostatistics, School of Public Health, Guangdong Pharmaceutical University, Guangzhou, China.

4 State Key Laboratory of Respiratory Disease and National Clinical Research Center for Respiratory Disease, the First Affiliated Hospital of Guangzhou Medical University, Guangzhou Medical University, Guangzhou, China.

# Xue-yan Zheng, Si-li Tang, Shu-li Ma and Wei-jie Guan shared co-first authorship.

\* **Correspondence author 1: Li-feng Lin.** Guangdong provincial center for disease control and prevention, Guangdong, China. Address: 160 Qunxian Road, Panyu district, Guangzhou, Guangdong, China. Fax: 020-31051821, Phone: 020-31051821, E-mail: [1396320174@qq.com](mailto:1396320174@qq.com).

**Correspondence author 2: Yan-jun Xu.** Guangdong provincial center for disease control and prevention, Guangdong, China. Address: 160 Qunxian Road, Panyu district, Guangzhou, Guangdong, China. Fax: 020-31051492, Phone: 020-31051353, E-mail: [759888406@qq.com](mailto:759888406@qq.com).

Word count, excluding title page, abstract, references, figures and tables: 2447

**Abstract**

**Objective:** To ascertain the trends of injury mortality during the COVID-19 period in southern China.

**Methods:** We conducted a population-based retrospective analysis to compare mortality changes of all-cause injury and transport injuries, poisoning, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence, and stratified by sex and age. Comparisons were made between the COVID-19 period (between Jan 2020 and Jun 2020) and control period (between Jan 2019 and Jun 2019) in Guangdong, China. We used negative binomial models to explore the associations of deaths during the COVID-19 period, according to different sex and age strata..

**Results:** The all-cause injury mortality in Guangdong province decreased significantly from 28.65 per 100,000 population during the control period to 23.24 per 100,000 population during COVID-19 pandemic period. Similar results were found in specific injury categories. Mortality changes of self-harm increased by 127.36% in the 0-14-year group during the COVID-19 period as compared with the control period. Although mortality changes in some groups did not reach statistical significance, some increases were also noteworthy during the COVID-19 period (i.e. self-harm, transport injury and falls) in the 70-79-year group. The respective increase in mortality changes was 16.86%, 3.32% and 4.92%.

**Conclusion:** There was a decreased mortality of all-cause injury, transport injury and drowning during the COVID-19 pandemic. However, the increase in mortality associated with falls, fire/heat/hot substance injury and self-harm in specific age population warrant targeted control and prevention measures for the population at risk.

**Key Words:** Injury; Mortality; COVID-19



### Strengths and limitations of this study

1. This is the first study which demonstrated the trends of changes in multiple injury mortality at different age and sex population at provincial level in China, during the COVID-19 period.
2. This is the first study comparing the injury mortality between COVID-19 period and the control period.
3. The completeness of death surveillance in Guangdong province was estimated using an empirical method to minimize under-reporting.
4. The causative effect of the COVID-19 epidemic on injury mortality could not be confirmed due to the limitation of the observational study.
5. There was a lack of injury incidence which should be regarded as another limitation of measuring the injury-associated burden.

## Introduction

During the coronavirus disease 2019 (COVID-19) pandemic, strict quarantine measures have been introduced to curb the transmission of severe acute respiratory syndrome coronavirus-2 in mainland China, including the people who have not contracted COVID-19 patients [1]. Guangdong is a major province which has suffered from one of the major massive epidemics of COVID-19 in mainland China. The government had enforced stringent quarantine and lockdown measures with an unprecedented effort to control the COVID-19 outbreak. Except for those who were responsible for providing living necessities and emergency services, the workforce has ceased working since the Chinese Lunar New Year (January 24th, 2020) and were requested to return to work after February 10<sup>th</sup>, 2020. The COVID-19 has also markedly dampened the social orders and economy around the globe [2].

Recent studies have showed that the COVID-19 pandemic confers a profound effect on all aspects of society which is also extended to the mental health. Significant decreases in acute coronary syndrome-related hospitalization and out-of-patient rates have been reported in Italy early during the COVID-19 outbreak [3-4]. The projected increases in suicide have also been linked to the COVID-19 outbreak in Canada [5]. The vicarious traumatization scores of the general public have recently been shown to be significantly higher than those of the front-line nurses [6]. Different levels of psychological impacts including stress, anxiety and depression might be the reasons for the increase in suicide events. Multidisciplinary research priorities for the COVID-19 pandemic have called for an urgent action for mental health science [7].

Guangdong province has 108 million permanent residents that account for 8.03% of the population in mainland China. Twenty-one cities with 122 counties are located in Guangdong province. Compared with other provinces, Guangdong has achieved the highest gross domestic product and become the most developed province with the largest population in southern China. Currently, little is known about the mortality changes of injury including suicide in different age and sex strata during the COVID-19 period in southern China.

We hypothesized that there would be both physical and mental health issues

1  
2  
3  
4 caused by the lockdown and quarantine measures during COVID-19 period. We sought  
5 to ascertain the injury mortality changes in Guangdong, China. This might help provide  
6 the evidence about the *status quo* of injury and mental health issues, as well as the  
7 guidance and actionable information for governments and public health authorities  
8 during the COVID-19 pandemic period.  
9  
10  
11  
12

## 13 14 15 **Methods and material**

### 16 17 ***Study design and data source***

18  
19 We conducted a population-based retrospective analysis to compare the mortality  
20 changes of injury in different categories (including transport injuries, poisonings, falls,  
21 fire/heat/hot substances, drowning, self-harm and interpersonal violence which were  
22 stratified by sex and age) between the study and control period. The study period was  
23 defined as the duration between the first cases being identified and the time when  
24 quarantine measures were implemented in Guangdong (January 1st 2020) and the  
25 data cut-off (June 30<sup>th</sup> 2020). The control period was defined as a corresponding  
26 period during the previous year (from 1st January 2019 to 30th June 2019). Death  
27 registration is an all-cause of death surveillance which covers the whole population  
28 living in Guangdong province. Mortality data was derived from Chinese Center for  
29 Disease Control and Prevention (CDC) Cause of Death Reporting System [8]. We  
30 performed analysis based on the 21 cities because the population size remained stable  
31 and cities constituted an important administrative unit in Guangdong province.  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43

### 44 45 ***Definition of major injury category***

46  
47 Injury deaths were identified according to the ICD-10 codes recommended by the  
48 US CDC [9-10], based on the diagnostic codes of V01-Y89. Based on published studies  
49 and the ICD-10 codes of injury, we selected several categories of injury: transport  
50 injuries (V01-V04,V06,V09-V80,V87,V89,V99), poisonings (X40-X49), falls (W00-W19),  
51 fire, heat, and hot substances (X00-X09), drowning (W65-W74), self-harm (X60-  
52 X84,Y87.0) and interpersonal violence (X85-Y09,Y87.1).  
53  
54  
55  
56  
57

### 58 59 ***Statistical analyses***

60 The registered population number in different age and sex strata in both 2019 and

2020 that corresponded to different cities in Guangdong province were obtained from the Population Basic Information System, by using as the denominators for mortality calculation. The percentage changes were calculated with the following formula:

$$\frac{\text{Mortality in COVID-19 period} - \text{Mortality in control period in 2019}}{\text{Mortality in control period in 2019}} \times 100\%$$

The completeness of death surveillance in Guangdong was estimated empirically [11]. Briefly, the following equation was applied to predict the completeness for both sexes:

$$\text{logit}(C^{\text{All}}) = (\text{RegCDR}_{\text{sq}} \times -0.0238) + (\text{RegCDR} \times 0.8419) + (\%65 \times -19.6118) + (\ln(5q0) \times -1.5135) + (\text{Year} \times -0.0251) + 44.3755 + \gamma$$

where  $C^{\text{All}}$  was the completeness of registration of all ages,  $\text{logit}(C^{\text{All}})$  equated to

$$\ln\left(\frac{C^{\text{All}}}{1 - C^{\text{All}}}\right), \text{RegCDR}$$
 was the registered crude death rate (CDR),  $\text{RegCDR}_{\text{sq}}$  was

the square of  $\text{RegCDR}$ , %65 was the fraction of the population aged 65 years or greater,

$\ln(5q0)$  was the natural log of the under-5 mortality rate,  $\text{Year}$  was calendar year,  $\gamma$

was a random effect, Predicted completeness was converted by using the inverse logit:

$$\frac{e^{\text{logit}(C^{\text{All}})}}{e^{\text{logit}(C^{\text{All}})} + 1}$$

Because of the overdispersion of injury deaths, we used negative binomial models to explore the associations of deaths within the COVID-19 period in different sex and age strata [12-13]. All statistical analyses were conducted using Stata statistical software version 12.1. Differences were considered statistically significant in 2-tailed tests if p-values were less than 0.05.

### **Patient and Public Involvement**

No patient involved

### **Results**

The completeness was 97.03% and 98.53% based on the empirical estimation, respectively. The all-cause injury mortality in Guangdong province decreased from

28.65 per 100,000 population in the control period to 23.24 per 100,000 people in the COVID-19 pandemic ( $P < 0.05$ ). Furthermore, the mortality of specific injury categories including transport injuries (5.06 per 100,000 population vs. 7.11 per 100,000 population), poisonings (1.04 per 100,000 population vs. 1.18 per 100,000 population), falls (8.45 per 100,000 population vs. 9.31 per 100,000 population), fire, heat, and hot substances (0.17 per 100,000 population vs. 0.24 per 100,000 population), drowning (1.23 per 100,000 population vs. 1.87 per 100,000 population), self-harm (3.04 per 100,000 population vs. 3.73 per 100,000 population), interpersonal violence (0.16 per 100,000 population vs. 0.29 per 100,000 population) decreased significantly during the COVID-19 pandemic as compared with the control period. (All  $P < 0.05$ , **Table 1**)

**Table 1. Comparison of mortality for injury causes between the onset of the Covid-19 Outbreak and the control period in Guangdong province**

| Injury subtypes                       | Study period<br>(1/100000) | Control period<br>(1/100000) | Changes<br>(%) | <i>P</i> |
|---------------------------------------|----------------------------|------------------------------|----------------|----------|
| <b>All cause of injury</b>            | 23.24                      | 28.65                        | -18.86         | < 0.0001 |
| <b>Transport injuries</b>             | 5.06                       | 7.11                         | -28.80         | < 0.0001 |
| <b>Poisonings</b>                     | 1.04                       | 1.18                         | -11.71         | 0.028    |
| <b>Falls</b>                          | 8.45                       | 9.31                         | -9.30          | < 0.0001 |
| <b>Fire, heat, and hot substances</b> | 0.17                       | 0.24                         | -28.41         | 0.012    |
| <b>Drowning</b>                       | 1.23                       | 1.87                         | -34.51         | < 0.0001 |
| <b>Self-harm</b>                      | 3.04                       | 3.73                         | -18.46         | < 0.0001 |
| <b>Interpersonal violence</b>         | 0.16                       | 0.29                         | -43.19         | < 0.0001 |

Except for the increased death rate in Zhuhai (9.89%) and Qingyuan city (0.52%), the death rate of all-cause injuries in 11 cities decreased significantly during the COVID-19 period as compared with the control period. The mortality of transport injuries in 17 cities declined significantly during the COVID-19 period. The death rate associated with falls decreased markedly (ranging from 0.16% to 44.48%) in 16 cities, while the mortality rate increased notably (ranging from 0.07% to 28.28%) in Guangzhou, Zhuhai, Heyuan, Qingyuan and Zhongshan city. Self-harm mortality

increased by 4.12% to 24.71% in Zhuhai, Zhaoqing, Meizhou, Yangjiang, Zhongshan and Jieyang, while the self-harm mortality decreased in other cities. (E-Table 1-2, Figure 1)

The mortality from all-cause and specific category injuries (including transport injuries, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence) decreased significantly in the total population, and in both males and females, with exception of heat and hot substances in females (Table 2, Figure 2). Interestingly, stratification of the study population into different age groups revealed a significantly increased mortality. The self-harm mortality in the 0-14-year group significantly increased in males, females and the general population. Although the increased mortality of self-harm, transport injury, falls and interpersonal violence in the 70-79-year group did not reach statistical significance, the increase in mortality in this age group was noteworthy. Moreover, there was an insignificant increase in mortality from fire, heat, and hot substances in the 80+-year group in both sexes and from falls in the 80+-year group in males. (Table 2, Figure 3)

The number of deaths due to all-cause injuries and specific types of injuries in different age group and cities were provided in supplementary material. (E-Table 3-5)

**Table 2. Mortality changes in injury causes between the Covid-19 Outbreak and Control Period in different age groups of the male and female population in Guangdong province.**

| Sex strata | Age group | Transport injuries | Poisonings | Falls   | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All-cause of injury |
|------------|-----------|--------------------|------------|---------|--------------------------------|----------|-----------|------------------------|---------------------|
| Male       | 0-14      | -32.25*            | -39.30     | -13.19  | -69.83*                        | -19.32   | 139.71*   | 56.90                  | -<br>22.50*         |
|            | 15-59     | -31.56*            | -10.15     | -16.89* | -48.01*                        | -32.84*  | -24.25*   | -55.36*                | -<br>25.99*         |
|            | 60-69     | -35.86*            | 3.30       | -27.63* | -42.45                         | -45.88*  | -19.98    | -35.54                 | -<br>29.49*         |
|            | 70-79     | 7.44               | -0.94      | 6.75    | -40.91                         | -41.31*  | 21.41     | 87.11                  | 2.71                |
|            | 80+       | -13.68             | -6.54      | 5.45    | 32.16                          | -15.04   | -43.68*   | 3.84                   | 0.53                |
|            | Total     | -27.06*            | -9.16      | -8.72*  | -39.99*                        | -30.90*  | -20.19*   | -40.54*                | -<br>19.56*         |
| Female     | 0-14      | -36.34*            | -35.24     | -8.50   | -6.46                          | -55.27*  | 115.13*   | -48.98                 | -                   |

|           |       |         |         |         |         |         |         |         |        |
|-----------|-------|---------|---------|---------|---------|---------|---------|---------|--------|
|           |       |         |         |         |         |         |         |         | 37.04* |
|           |       |         |         |         |         |         |         |         | -      |
|           | 15-59 | -36.42* | -20.97  | -10.48  | -36.32  | -41.98* | -19.51* | -47.01* | 26.13* |
|           |       |         |         |         |         |         |         |         | -      |
|           | 60-69 | -43.33* | -14.22  | -21.81  | 51.38   | -50.51* | -35.40* | -52.69  | 35.63* |
|           | 70-79 | -2.53   | -22.83  | 3.49    | 49.58   | -0.44   | 12.40   | -28.77  | 2.51   |
|           | 80+   | -33.09* | 101.69  | -6.87*  | 31.10   | -42.37* | 0.85    | 0.85    | -6.86* |
|           | Total | -32.78* | -16.62  | -9.93*  | -1.21   | -40.67* | -15.17* | -46.06* | 17.58* |
|           |       |         |         |         |         |         |         |         | -      |
| General   | 0-14  | -34.07* | -36.68* | -11.18  | -52.00  | -31.89* | 127.36* | -16.00  | 28.87* |
| populatio |       |         |         |         |         |         |         |         | -      |
| n         | 15-59 | -32.71* | -13.13* | -15.56* | -44.10* | -35.25* | -22.67* | -51.68* | 25.99* |
|           |       |         |         |         |         |         |         |         | -      |
|           | 60-69 | -38.81* | -3.04   | -27.01* | -31.62  | -48.12* | -27.24* | -45.90  | 32.22* |
|           | 70-79 | 3.32    | -12.44  | 4.92    | -22.48  | -20.40  | 16.83   | 27.69   | 2.12   |
|           | 80+   | -21.92  | 29.26   | -2.45   | 31.20   | -33.03* | -22.78  | 2.05    | -4.04  |
|           | Total | -28.80* | -11.71* | -9.30*  | -28.41* | -34.51* | -18.46* | -43.19* | 18.86* |

\*: statistical significance using negative binomial model for comparison of COVID-19 period and control period in 2019 (P< 0.05)

## Discussion

Our study revealed that the mortality from all-cause of injury and specific categories of injury (including transport injuries, poisonings, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence) has decreased dramatically, which might have resulted from the COVID-19 pandemic. However, stratification of the study population into different city, age and sex strata has unraveled a significantly increased mortality in certain types of injury. Despite that the mortality changes in some strata did not reach statistical significance, there has been a notably increased mortality during the COVID-19 period (i.e. self-harm, transport injury, falls, interpersonal violence in the 70-79 year group). This has shed light on the priorities and longer-term strategies for injury and mental health scientific research, control and prevention. To our knowledge, this is the first study that demonstrated the injury mortality at different age and sex strata at provincial level in mainland China. Our findings have added new insights by providing comparisons between the COVID-19

1  
2  
3  
4 pandemic period and the control period in 2019.

5  
6 Because our study was conducted during the COVID-19 pandemic when stringent  
7 lockdown and quarantine measures were enforced in mainland China, the most  
8 prominent impact of COVID-19 on injury would not be fully captured. During the  
9 COVID-19 outbreak, most people avoided outdoor activities to minimize the use of  
10 healthcare services and the likelihood of SARS-CoV-2 infection (Severe Acute  
11 Respiratory Syndrome Coronavirus-2). Consequently, there has been a notable  
12 decrease in the mortality from transport injury and drowning at all age strata. Similar  
13 results have been documented in the UK [14] and India [15]. Degenerative spine and  
14 traumatic brain injuries also decreased significantly during the pandemic in UK [14].  
15 The lockdown has grossly decreased the disability-adjusted life year caused by road  
16 traffic injury [15].  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26

27 It remains unclear why the mortality of fire, heat, and hot substances in the  
28 general population decreased during the COVID-19 period based on the existing data  
29 and literature reports. In line with our study, some researchers have demonstrated a  
30 higher mortality in the elderly [16-17]. In the UK, scalds were accounted for 60% of  
31 deaths of fire, heat, and hot substances in the >75-year group [18]. By contrast to the  
32 findings from the previous study, fire or smoke inhalation caused by fire are the main  
33 causes of the increased mortality among the elderly during the COVID-19 period in our  
34 study. People who died from fire, heat and hot substances were reported from the  
35 rural areas, where the elderly living alone were more likely to use biomass fuel (i.e.,  
36 wood, coal, animal dung, crop residues) for cooking and heating. A comprehensive  
37 strategy that integrates public education, distribution of firefighting equipment,  
38 adequate supervision for the vulnerable adults while heating and cooking and the use  
39 of aging electric appliance in the elderly would be indispensable to improve public  
40 health.  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53

54 The causes of death from interpersonal violence have been multifactorial.  
55 Theoretically, unemployment and fear of acquiring COVID-19 infection would have  
56 predisposed to an increased incidence of household interpersonal violence that is  
57 usually not fatal. However, both the incidence and mortality of social interpersonal  
58  
59  
60



1  
2  
3  
4 violence would sharply decrease because of the stringent lockdown and quarantine  
5  
6 measures which could be fatal. The decrease in the mortality associated with social  
7  
8 interpersonal violence might have largely been offset by the non-fatal incidence of  
9  
10 household interpersonal violence.

11  
12 The death rate of falls has been declining despite a notable increase in the elderly,  
13  
14 which is probably due to the increased life expectancy in the past two decades. A  
15  
16 greater proportion of the elderly living with chronic diseases were at risk of falls [19].  
17  
18 This problem tended to aggravate during the COVID-19 period because the elderly  
19  
20 remain exposed to trauma due to domestic falls with a reduced number of health  
21  
22 services [20]. In this case, the elderly suffered from a higher risk of disability or death  
23  
24 due to the delayed care and treatment for fall-related injuries [21-22]. Given the  
25  
26 relatively high burden of falls among the elderly, a systematic implementation to  
27  
28 reduce the incidence of injuries from falls would be urgently needed. These measures  
29  
30 include a sufficient medical and occupational-therapy [23], professional environment  
31  
32 hazard assessment and modification [24], vitamin D and calcium supplementation, hip  
33  
34 protectors, reduction of many of the predisposing and situational risk factors [25].

35  
36 Self-harm is becoming a more pressing concern as the pandemic is spreading  
37  
38 rapidly and has the longer-term effects on the general population, the economy, and  
39  
40 the vulnerable population. The infectious disease epidemics seemed to serve as a  
41  
42 catalyst to trigger the suicidal thought of people with mental health problems [26-27].  
43  
44 Our results revealed an increased death rate for self-harm in the 0-14-year and 70-79-  
45  
46 year group in both sexes. The likely adverse effects of the pandemic on children's  
47  
48 mental health might be exacerbated by fear of being infected by SARS-CoV-2, self-  
49  
50 isolation and physical distancing because of school closure [28]. These contributed to  
51  
52 an increase in the prevalence of post-traumatic stress disorder symptoms, depression,  
53  
54 anxiety and stress [29]. In conjunction with a higher risk of being exposed to the family  
55  
56 conflicts, the household physical violence, academic stress and economic damage  
57  
58 which were caused by the COVID-19 crisis might have collectively led to an increased  
59  
60 rate of suicide among children [30]. A loss of employment, financial stressors and  
alcohol consumption, which have also been the well-recognized risk factors causing

1  
2  
3  
4 family conflict [31], might have aggravated during the lockdown. Despite of the mental  
5 health problems, the family conflict, the elderly might be increasingly concerned  
6 because of the extraordinarily high case-fatality rate [32]. This might have also  
7 contributed to the increased risk of self-harm in the elderly. Selective and universal  
8 interventions are required for the targeted individuals at risk of suicide, including  
9 making evidence-based online interventions available, increasing volunteer workforce  
10 for crisis hotlines, providing financial safety nets for unemployment support [33].  
11 Public health responses must ensure that those facing interpersonal violence are  
12 supported and that safe drinking messages are communicated, particularly for the  
13 bereaved individuals. Accessible health education and promotion for COVID-19 is  
14 recommended, because a previous study found that people who are proactively  
15 engaged in hand hygiene could have a decrease in the likelihood that the workforce  
16 experience psychiatric symptoms [29,34].  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28

29 Some limitations should be addressed. There was a lack of reliable injury  
30 incidence data. Therefore, the comparability of mortality data and incidence data due  
31 to the death registration completeness and coverage should be interpreted with  
32 caution. Although we have used an empirical method to minimize the  
33 underestimation in the death surveillance, the magnitude of completeness of the  
34 mortality data varied considerably for children and adult deaths based on the GBD  
35 2010 study's finding [35]. The completeness of data in children was usually lower than  
36 that in adults in Latin America and Asia. Second, caution should also be exercised  
37 regarding the causative effect of the COVID-19 epidemic on injury mortality because  
38 of the limitation of the observational study design. Despite these limitations, our  
39 findings remained robust. The death registration is an all-cause of death surveillance  
40 which covered all the population residing in Guangdong. Data from the registration  
41 system in the recent years have been aligning well with the vital registration data that  
42 achieved a large increase in the coverage over the past decade [36].  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

56 In conclusion, the COVID-19 pandemic was associated with a decreased mortality  
57 of all injury, transport injury and drowning. However, the increase in the mortality of  
58 falls, fire, heat, and hot substances injury, self-harm in specific age populations during  
59  
60

1  
2  
3  
4 the COVID-19 period still warranted the targeted and universal interventions for the  
5 mass public.  
6  
7  
8

9  
10 **Acknowledgement:** None.

11 **Contributors:** Xue-yan Zheng<sup>1#</sup>, Si-li Tang<sup>1,2#</sup>, Shu-li Ma<sup>1,3#</sup>, Xiao-jun Xu<sup>1</sup>, Hao-feng Xu,  
12 **Ying-shan Xu<sup>1</sup>, Yan-jun Xu<sup>1\*</sup>, Li-feng Lin**  
13  
14

15 Xiao-jun Xu, Hao-feng Xu, Ying-shan Xu, Yan-jun Xu and Li-feng Lin conceived of the  
16 study and provided overall guidance. Xue-yan Zheng, Si-li Tang, Shu-li Ma, Wei-jie  
17 Guan and Li-feng Lin prepared the first draft and finalized the manuscript based on  
18 comments from all other authors and reviewer feedback. Xue-yan Zheng, Wei-jie  
19 Guan, Yan-jun Xu and Li-feng Lin played a key role in formulating the analysis. All other  
20 authors contributed to the analysis and reviewed the manuscript.  
21  
22  
23  
24  
25

26  
27 **Funding:** This research received no specific grant from any funding agency in the  
28 public, commercial or not-for-profit sectors.  
29  
30

31  
32  
33 **Competing interests:**

34 We declare no competing interests.  
35  
36  
37  
38

39 **Data availability statement**

40 All data relevant to the study are included in the article or uploaded as supplementary  
41 information  
42  
43  
44  
45

46 **Reference:**

- 47  
48 1. Hao F, Tan W, Jiang L, et al. Do psychiatric patients experience more psychiatric  
49 symptoms during COVID-19 pandemic and lockdown? A case-control study with  
50 service and research implications for immunopsychiatry. *Brain Behav Immun.*  
51 2020;87:100-106.  
52  
53 2. Gautam R, Sharma M. 2019-nCoV pandemic: A disruptive and stressful atmosphere  
54 for Indian academic fraternity. *Brain Behav Immun.* 2020;88:948-949.  
55 doi:10.1016/j.bbi.2020.04.025.  
56  
57  
58  
59  
60

- 1  
2  
3  
4 3. Baldi E, Sechi GM, Mare C, et al. Out-of-Hospital Cardiac Arrest during the Covid-19  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
13. Statistical Consulting Group. Negative binomial regression: Stata annotated output.  
Available from: <https://stats.idre.ucla.edu/stata/output/negative-binomial-regression/>. Accessed 2017 Jun 1.
14. Jayakumar N, Kennion O, Villabona AR, Paranathala M, Holliman D. Neurosurgical

1  
2  
3  
4 Referral Patterns During the Coronavirus Disease 2019 Pandemic: A United Kingdom  
5 Experience. *World Neurosurg.* 2020; 144:e414-e420.

6  
7 15. Jain A, Goyal V, Varma C. Reflection of Epidemiological Impact on Burden of Injury  
8 in Tertiary Care Centre, Pre-COVID and COVID Era: "Lockdown, a Good Fortune for  
9 Saving Life and Limb". *Indian J Surg.* 2020; 24:1-5.

10  
11 16. Sadeghian F, Saeedi Moghaddam S, Saadat S, et al. The trend of burn mortality in  
12 Iran - A study of fire, heat and hot substance-related fatal injuries from 1990 to 2015.  
13 *Burns.* 2019;45(1):228-240.

14  
15 17. Tang K, Jian L, Qin Z, Zhenjiang L, Gomez M, Beveridge M. Characteristics of burn  
16 patients at a major burn center in Shanghai. *Burns* 2006;32: 1037-43.

17  
18 18. Hussain A, Dunn K. Burn related mortality in Greater Manchester: 11-year review  
19 of Regional Coronial Department Data. *Burns.* 2015;41(2):225-234.

20  
21 19 Centers for Disease Control and Prevention. Fatalities and injuries from falls among  
22 older adults, United States, 1993–2003 and 2001–2005. *MMWR Morb Mortal Wkly*  
23 *Rep* 2006; 55: 1221–24.

24  
25 20. Gumina S, Proietti R, Polizzotti G, Carbone S, Candela V. The impact of COVID-19  
26 on shoulder and elbow trauma: an Italian survey [published online ahead of print,  
27 2020 May 20]. *J Shoulder Elbow Surg.* 2020; S1058-2746(20)30401-8.

28  
29 21. Tong HJ, Huang CY. Changes of family structure and their social influence in  
30 contemporary China. *Xi Bei Ren Kou Za Zhi* 2015; 6: 81–84 (in Chinese).

31  
32 22. Gao M, Li Y, Zhang S, et al. Does an empty nest affect elders' health? Empirical  
33 evidence from China. *Int J Environ Res Public Health* 2017; 14: E463.

34  
35 23. Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in  
36 the elderly trial (PROFET): a randomised controlled trial. *Lancet.* 1999; 353(9147):93-  
37 97.

38  
39 24. Keall MD, Pierse N, Howden-Chapman P, et al. Home modifications to reduce  
40 injuries from falls in the home injury prevention intervention (HIPI) study: a cluster-  
41 randomised controlled trial. *Lancet.* 2015;385(9964):231-238.

42  
43 25. Kannus P, Sievänen H, Palvanen M, Järvinen T, Parkkari J. Prevention of falls and  
44 consequent injuries in elderly people. *Lancet.* 2005; 366(9500):1885-1893.

- 1  
2  
3  
4 26. Wasserman IM. The impact of epidemic, war, prohibition and media on suicide:  
5 United States, 1910–1920. *Suicide Life Threat Behav* 1992; 22: 240–54.
- 6  
7 27. Cheung YT, Chau PH, Yip PS. A revisit on older adults suicides and severe acute  
8 respiratory syndrome (SARS) epidemic in Hong Kong. *Int J Geriatr Psychiatry* 2008; 23:  
9 1231–38.
- 10  
11 28. Yao H, Chen JH, Xu YF. Patients with mental health disorders in the COVID-19  
12 epidemic. *Lancet Psychiatry* 2020; 7: e21
- 13  
14 29. Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general  
15 population during the COVID-19 epidemic in China. *Brain Behav Immun.* 2020;87:40-  
16 48.
- 17  
18 30. Hoekstra PJ. Suicidality in children and adolescents: lessons to be learned from the  
19 COVID-19 crisis. *Eur Child Adolesc Psychiatry.* 2020;29(6):737-738.
- 20  
21 31. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of  
22 economic crises and alternative policy responses in Europe: an empirical analysis.  
23 *Lancet* 2009; 374: 315-23.
- 24  
25 32. Guan WJ, Liang WH, Zhao Y, et al. Comorbidity and its impact on 1590 patients  
26 with COVID-19 in China: a nationwide analysis. *Eur Respir J.* 2020;55(5):2000547.
- 27  
28 33. Gunnell D, Appleby L, Arensman E, et al. Suicide risk and prevention during the  
29 COVID-19 pandemic. *Lancet Psychiatry.* 2020;7(6):468-471.
- 30  
31 34. Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19  
32 pandemic stressful? A study on immediate mental health status and  
33 psychoneuroimmunity prevention measures of Chinese workforce. *Brain Behav*  
34 *Immun.* 2020;87:84-92.
- 35  
36 35. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235  
37 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the  
38 Global Burden of Disease Study 2010. *Lancet* 2012;380:2095–128.
- 39  
40 36 . GBD 2017 Mortality Collaborators. Global, regional, and national age- and  
41 sex-specific mortality and life expectancy for 195 countries and territories, 1950–2017:  
42 a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018;392:  
43 1684–735.
- 44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

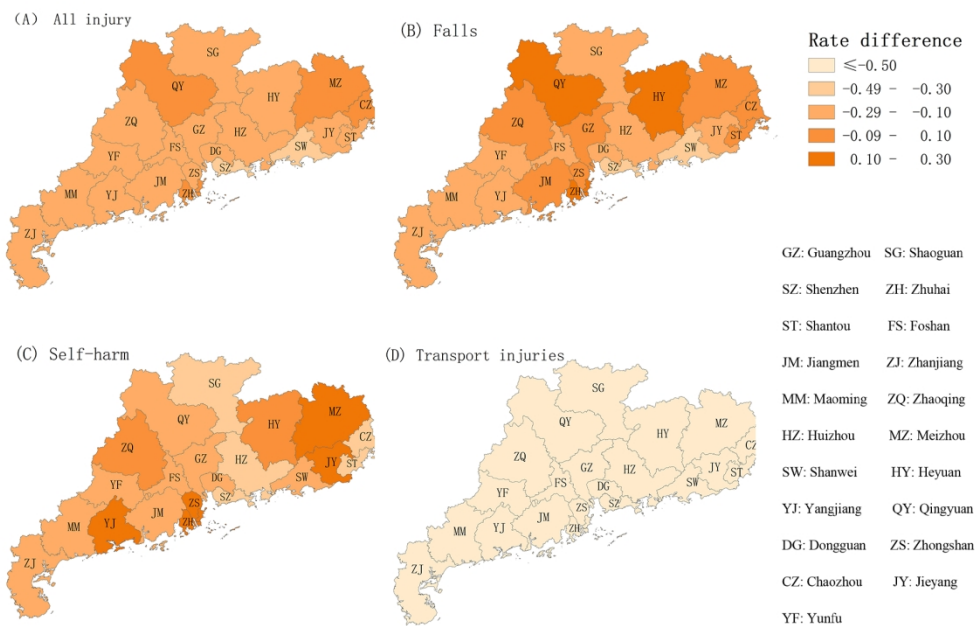
1  
2  
3  
4  
5  
6  
7  
8  
9 **Figure legends:**

10 **Figure 1. All injury, transport injuries, falls and self-harm mortality changes between**  
11 **the Covid-19 pandemic period and control period in 21 cities in Guangdong province,**  
12 **China.**

13  
14  
15  
16  
17 GZ: Guangzhou; SG: Shaoguan; SZ: Shenzhen; ZH: Zhuhai; ST: Shantou; FS: Foshan; JM:  
18 Jiangmen; ZJ: Zhanjiang; MM: Maoming; ZQ: Zhaoqing; HZ: Huizhou; MZ: Meizhou; SW:  
19 Shanwei; HY: Heyuan; YJ: Yangjiang; QY: Qingyuan; DG: Dongguan; ZS: Zhongshan; CZ:  
20 Chaozhou; JY: Jieyang; YF: Yunfu.  
21  
22  
23  
24  
25  
26  
27  
28  
29

30 **Figure 2. All injury, transport injuries, falls and self-harm in different sex groups**  
31 **between the Covid-19 pandemic period and control period in 21 cities in Guangdong**  
32 **province, China.**

33  
34  
35  
36  
37  
38  
39  
40 **Figure 3. All injury, transport injuries, falls and self-harm mortality changes in**  
41 **different age and sex groups between the Covid-19 pandemic period and control**  
42 **period in Guangdong province, China.**  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



31 Figure 1. All injury, transport injuries, falls and self-harm mortality changes between the Covid-19 pandemic  
32 period and control period in 21 cities in Guangdong province, China.

33 160x119mm (300 x 300 DPI)



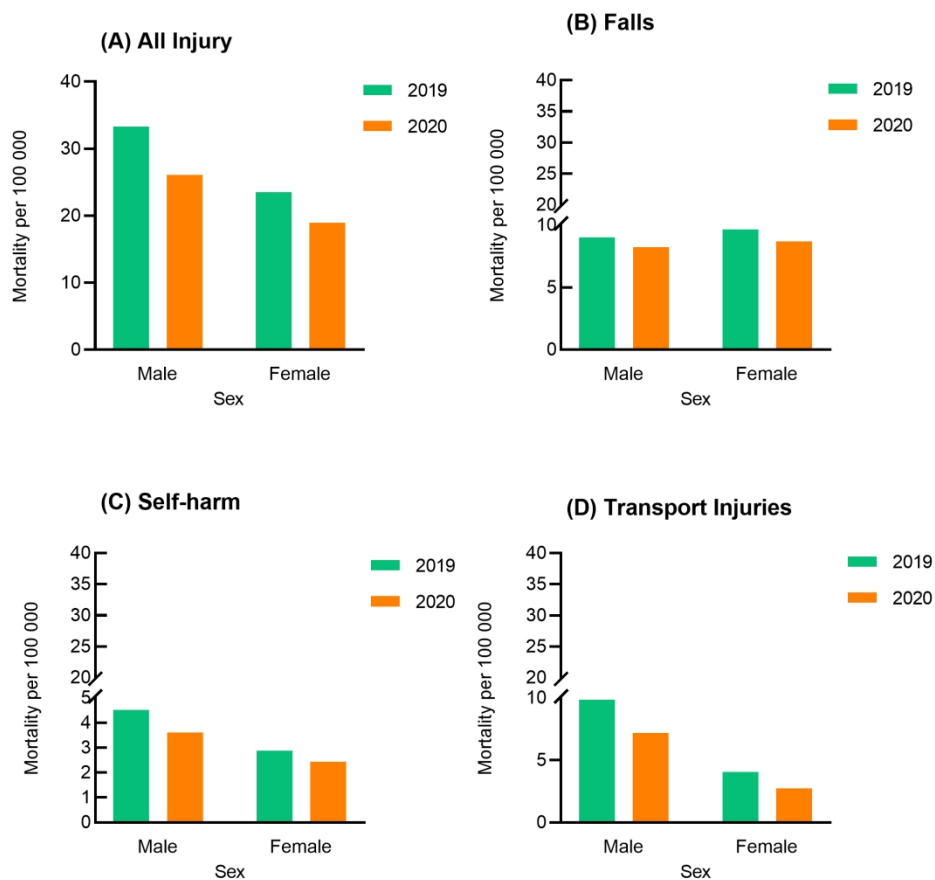


Figure 2. All injury, transport injuries, falls and self-harm in different sex groups between the Covid-19 pandemic period and control period in 21 cities in Guangdong province, China.

191x181mm (300 x 300 DPI)

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

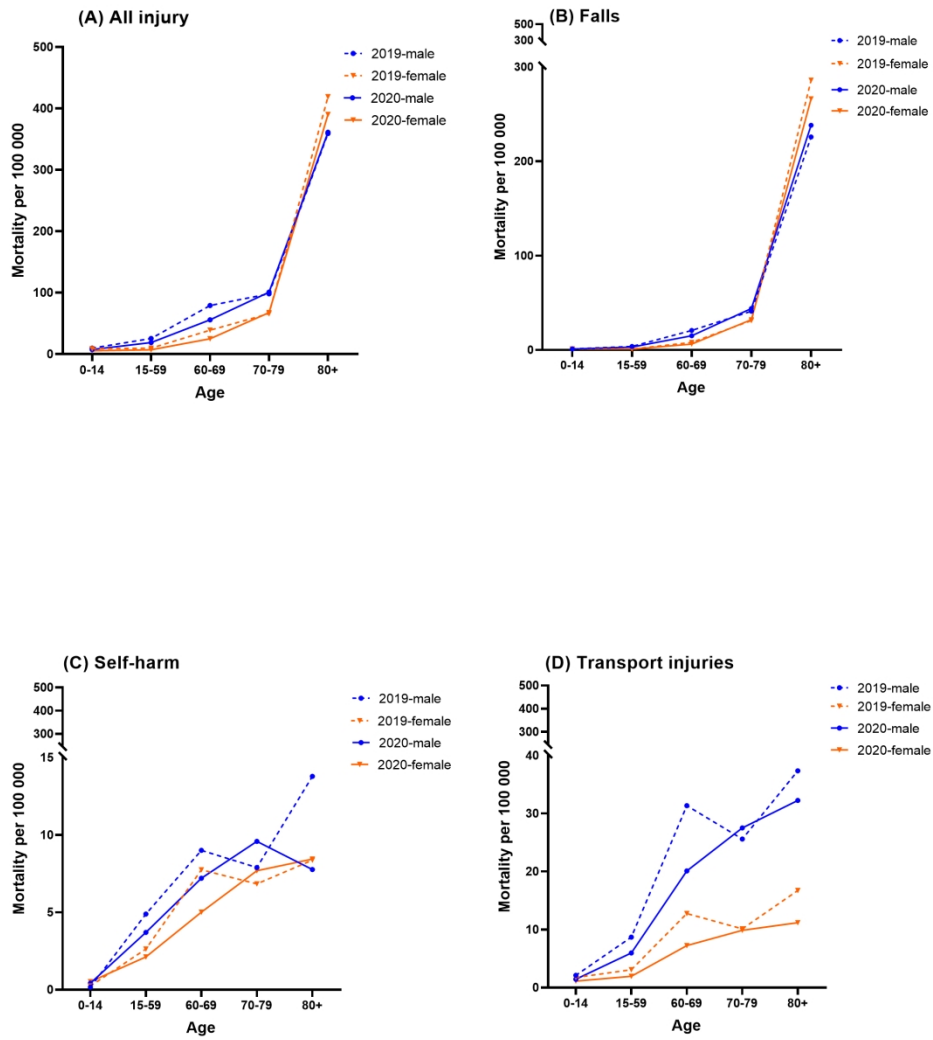


Figure 3. All injury, transport injuries, falls and self-harm mortality changes in different age and sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

198x216mm (300 x 300 DPI)

**E-Table 1. Mortality changes for injury causes in 21 cities of Guangdong, China between the Covid-19 Outbreak and Control Period in 2019.**

|           | Transport injuries | Poisonings | Falls   | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All injury |
|-----------|--------------------|------------|---------|--------------------------------|----------|-----------|------------------------|------------|
| Guangzhou | -24.44*            | -34.69*    | 3.04    | -52.10                         | -15.31   | -27.80*   | -32.59                 | -15.91*    |
| Shaoguan  | -21.59*            | -15.56     | -23.96* | -80.43                         | -36.08*  | -37.32*   | -75.53                 | -26.99*    |
| Shenzhen  | -71.26*            | -44.48*    | -44.48* | -100.00                        | -65.11*  | -33.23*   | -66.85*                | -43.55*    |
| Zhuhai    | -11.82             | 83.86      | 28.28   | -                              | -2.32    | 15.91     | -38.71                 | 9.89       |
| Shantou   | -29.92*            | -7.49      | -5.40   | -58.02                         | -        | -34.19*   | 80.69                  | -11.01     |
| Foshan    | -23.01*            | -4.62      | -15.05* | -18.25                         | -43.97*  | -13.04    | -68.21                 | -21.80*    |
| Jiangmen  | -7.92              | -38.49     | -3.97   | 193.09                         | -46.10*  | -17.50    | -30.22                 | -13.05*    |
| Zhanjiang | -25.31*            | -18.24     | -22.99* | 76.61                          | -19.29   | -19.58    | -75.47                 | -25.13*    |
| Maoming   | -29.77*            | -26.58     | -16.27  | -44.70                         | -35.09*  | -15.96    | 45.16                  | -27.33*    |
| Zhaoqing  | -40.75*            | -47.01*    | -1.19   | -21.91                         | -52.77*  | 4.12      | 13.88                  | -17.90*    |
| Huizhou   | -44.99*            | -16.52     | -12.96  | -26.95                         | -43.06*  | -45.78*   | -51.30                 | -28.22*    |
| Meizhou   | -21.70*            | 63.96*     | -5.19   | 47.57                          | 2.09     | 21.19     | -83.60                 | -1.38      |
| Shanwei   | -56.72*            | -2.05      | -35.39  | -100.00*                       | -21.64   | -19.54    | -100.00                | -42.23*    |
| Heyuan    | -29.16*            | 1.28       | 15.00   | 31.18                          | -45.34   | -3.95     | -                      | -11.26     |
| Yangjiang | -33.28*            | 128.64*    | -21.33  | 95.98                          | 11.35    | 24.71     | -2.01                  | -19.12*    |
| Qingyuan  | -9.59              | 39.44      | 17.42*  | -50.94                         | -40.57*  | -15.70    | -1.88                  | 0.52       |

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

|           |         |         |         |         |         |         |         |         |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| Dongguan  | -11.10  | -43.32* | -17.44* | -34.74  | -54.71* | -15.758 | -61.54* | -17.90* |
| Zhongshan | -40.26* | -45.44* | 0.07    | -78.45* | -36.45  | 24.70   | -75.75  | -18.59* |
| Chaozhou  | 6.93    | -1.74   | -0.16   | -26.30  | -45.96  | -33.53  | -       | -4.66   |
| Jieyang   | -35.11* | 14.83   | -27.02* | -26.18  | -18.55  | 23.03   | -1.58   | -17.69* |
| Yunfu     | -41.93* | 14.87   | -16.59  | 13.91   | -73.15* | -22.80  | 144.10  | -26.19* |
| Guangdong | -28.80* | -11.71* | -9.30*  | -28.41* | -34.51* | -18.46* | -43.19* | -18.86* |

\*: statistical significance using negative binomial model for comparison of COVID-19 period and control period in 2019 (P< 0.05)

For peer review only

**E-Table 2. Mortality for injury causes in Guangdong, China between the Covid-19 Outbreak and Control Period in 2019 in different age groups in male and female population.**

| Sex group                       | Age group | Transport injuries | Poisonings | Falls  | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All-cause of injury |
|---------------------------------|-----------|--------------------|------------|--------|--------------------------------|----------|-----------|------------------------|---------------------|
| <b>Control Period in 2019</b>   |           |                    |            |        |                                |          |           |                        |                     |
| Male                            | 0-14      | 2.12               | 0.41       | 1.18   | 0.25                           | 2.72     | 0.17      | 0.1                    | 9.57                |
|                                 | 15-59     | 8.7                | 1.69       | 3.75   | 0.17                           | 1.82     | 4.89      | 0.33                   | 25.35               |
|                                 | 60-69     | 31.36              | 2.42       | 20.74  | 0.87                           | 4.16     | 9         | 0.31                   | 79.04               |
|                                 | 70-79     | 25.61              | 1.56       | 41.12  | 1.74                           | 4.04     | 7.89      | 0.28                   | 98.13               |
|                                 | 80+       | 37.36              | 4.67       | 225.8  | 2.57                           | 7.71     | 13.78     | 0.7                    | 359.13              |
|                                 | Total     | 9.87               | 1.54       | 9.02   | 0.32                           | 2.29     | 4.51      | 0.29                   | 33.33               |
| Female                          | 0-14      | 1.74               | 0.63       | 1.11   | 0.12                           | 1.66     | 0.24      | 0.27                   | 8.71                |
|                                 | 15-59     | 3.08               | 0.72       | 1.02   | 0.09                           | 0.73     | 2.63      | 0.28                   | 9.57                |
|                                 | 60-69     | 12.77              | 1          | 8.09   | 0.13                           | 3.48     | 7.75      | 0.53                   | 38.9                |
|                                 | 70-79     | 10.13              | 1.6        | 31.11  | 0.44                           | 3.91     | 6.84      | 0.27                   | 65.77               |
|                                 | 80+       | 16.73              | 1.61       | 285.89 | 1.61                           | 10.14    | 8.37      | 0.16                   | 418.94              |
|                                 | Total     | 4.06               | 0.78       | 9.64   | 0.15                           | 1.41     | 2.87      | 0.29                   | 23.47               |
| General population              | 0-14      | 1.95               | 0.5        | 1.15   | 0.19                           | 2.25     | 0.2       | 0.17                   | 9.19                |
|                                 | 15-59     | 6.02               | 1.23       | 2.45   | 0.13                           | 1.3      | 3.81      | 0.31                   | 17.82               |
|                                 | 60-69     | 22.41              | 1.74       | 14.65  | 0.52                           | 3.83     | 8.4       | 0.42                   | 59.71               |
|                                 | 70-79     | 17.75              | 1.58       | 36.03  | 1.08                           | 3.97     | 7.36      | 0.27                   | 81.69               |
|                                 | 80+       | 25.15              | 2.86       | 261.38 | 2                              | 9.14     | 10.57     | 0.38                   | 394.54              |
|                                 | Total     | 7.11               | 1.18       | 9.31   | 0.24                           | 1.87     | 3.73      | 0.29                   | 28.65               |
| <b>Covid-19 Outbreak period</b> |           |                    |            |        |                                |          |           |                        |                     |

|    |            |       |       |      |        |      |      |      |      |        |
|----|------------|-------|-------|------|--------|------|------|------|------|--------|
| 1  |            |       |       |      |        |      |      |      |      |        |
| 2  |            |       |       |      |        |      |      |      |      |        |
| 3  |            |       |       |      |        |      |      |      |      |        |
| 4  |            |       |       |      |        |      |      |      |      |        |
| 5  | Male       | 0-14  | 1.44  | 0.25 | 1.02   | 0.08 | 2.2  | 0.42 | 0.15 | 7.42   |
| 6  |            | 15-59 | 5.96  | 1.52 | 3.12   | 0.09 | 1.22 | 3.7  | 0.15 | 18.76  |
| 7  |            | 60-69 | 20.11 | 2.5  | 15.01  | 0.5  | 2.25 | 7.2  | 0.2  | 55.74  |
| 8  |            | 70-79 | 27.52 | 1.55 | 43.9   | 1.03 | 2.37 | 9.58 | 0.52 | 100.79 |
| 9  |            | 80+   | 32.25 | 4.36 | 238.11 | 3.39 | 6.55 | 7.76 | 0.73 | 361.04 |
| 10 |            | Total | 7.2   | 1.4  | 8.23   | 0.19 | 1.58 | 3.6  | 0.17 | 26.81  |
| 11 |            |       |       |      |        |      |      |      |      |        |
| 12 | Female     | 0-14  | 1.11  | 0.41 | 1.02   | 0.11 | 0.74 | 0.52 | 0.14 | 5.48   |
| 13 |            | 15-59 | 1.96  | 0.57 | 0.92   | 0.06 | 0.42 | 2.12 | 0.15 | 7.07   |
| 14 |            | 60-69 | 7.24  | 0.86 | 6.32   | 0.2  | 1.72 | 5.01 | 0.25 | 25.05  |
| 15 |            | 70-79 | 9.88  | 1.23 | 32.19  | 0.66 | 3.89 | 7.69 | 0.19 | 67.42  |
| 16 |            | 80+   | 11.19 | 3.24 | 266.24 | 2.11 | 5.84 | 8.44 | 0.16 | 390.2  |
| 17 |            | Total | 2.73  | 0.65 | 8.68   | 0.15 | 0.83 | 2.43 | 0.16 | 19.35  |
| 18 |            |       |       |      |        |      |      |      |      |        |
| 19 | General    | 0-14  | 1.29  | 0.32 | 1.02   | 0.09 | 1.53 | 0.46 | 0.14 | 6.54   |
| 20 | population | 15-59 | 4.05  | 1.07 | 2.07   | 0.07 | 0.84 | 2.95 | 0.15 | 13.19  |
| 21 |            | 60-69 | 13.71 | 1.69 | 10.69  | 0.35 | 1.99 | 6.11 | 0.23 | 40.48  |
| 22 |            | 70-79 | 18.34 | 1.38 | 37.81  | 0.84 | 3.16 | 8.6  | 0.35 | 83.42  |
| 23 |            | 80+   | 19.63 | 3.69 | 254.96 | 2.62 | 6.12 | 8.17 | 0.39 | 378.6  |
| 24 |            | Total | 5.06  | 1.04 | 8.45   | 0.17 | 1.23 | 3.04 | 0.16 | 23.24  |
| 25 |            |       |       |      |        |      |      |      |      |        |
| 26 |            |       |       |      |        |      |      |      |      |        |
| 27 |            |       |       |      |        |      |      |      |      |        |
| 28 |            |       |       |      |        |      |      |      |      |        |
| 29 |            |       |       |      |        |      |      |      |      |        |
| 30 |            |       |       |      |        |      |      |      |      |        |
| 31 |            |       |       |      |        |      |      |      |      |        |
| 32 |            |       |       |      |        |      |      |      |      |        |
| 33 |            |       |       |      |        |      |      |      |      |        |
| 34 |            |       |       |      |        |      |      |      |      |        |
| 35 |            |       |       |      |        |      |      |      |      |        |
| 36 |            |       |       |      |        |      |      |      |      |        |
| 37 |            |       |       |      |        |      |      |      |      |        |
| 38 |            |       |       |      |        |      |      |      |      |        |
| 39 |            |       |       |      |        |      |      |      |      |        |
| 40 |            |       |       |      |        |      |      |      |      |        |
| 41 |            |       |       |      |        |      |      |      |      |        |
| 42 |            |       |       |      |        |      |      |      |      |        |
| 43 |            |       |       |      |        |      |      |      |      |        |
| 44 |            |       |       |      |        |      |      |      |      |        |
| 45 |            |       |       |      |        |      |      |      |      |        |
| 46 |            |       |       |      |        |      |      |      |      |        |

**E-Table 3. Numbers for injury causes in Guangdong, China between the Onset of the COVID-19 outbreak and control Period in 2019.**

| Injury subtypes                   | Study period<br>(No.) | Control period<br>(No.) |
|-----------------------------------|-----------------------|-------------------------|
| All cause of injury               | 12858                 | 15988                   |
| Transport injuries                | 2871                  | 3978                    |
| Poisonings                        | 591                   | 667                     |
| Falls                             | 4792                  | 5209                    |
| Fire, heat, and hot<br>substances | 97                    | 134                     |
| Drowning                          | 695                   | 1053                    |
| Self-harm                         | 1725                  | 2093                    |
| Interpersonal violence            | 93                    | 162                     |

**E-Table 4. Numbers for injury causes in Guangdong, China between the Covid-19 Outbreak and Control Period in 2019 in different age groups in male and female population.**

| Sex group                       | Age group | Transport injuries | Poisonings | Falls | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All-cause of injury |
|---------------------------------|-----------|--------------------|------------|-------|--------------------------------|----------|-----------|------------------------|---------------------|
| <b>Control Period in 2019</b>   |           |                    |            |       |                                |          |           |                        |                     |
| Male                            | 0-14      | 113                | 22         | 63    | 13                             | 145      | 9         | 5                      | 511                 |
|                                 | 15-59     | 1806               | 351        | 778   | 35                             | 378      | 1014      | 68                     | 5260                |
|                                 | 60-69     | 520                | 40         | 344   | 14                             | 69       | 149       | 5                      | 1312                |
|                                 | 70-79     | 288                | 18         | 462   | 20                             | 45       | 89        | 3                      | 1102                |
|                                 | 80+       | 165                | 21         | 997   | 11                             | 34       | 61        | 3                      | 1585                |
|                                 | Total     | 2892               | 451        | 2644  | 94                             | 672      | 1322      | 85                     | 9770                |
| Female                          | 0-14      | 74                 | 27         | 47    | 5                              | 71       | 10        | 11                     | 372                 |
|                                 | 15-59     | 582                | 136        | 194   | 18                             | 138      | 498       | 54                     | 1810                |
|                                 | 60-69     | 197                | 15         | 125   | 2                              | 54       | 120       | 8                      | 600                 |
|                                 | 70-79     | 117                | 19         | 361   | 5                              | 45       | 79        | 3                      | 763                 |
|                                 | 80+       | 107                | 10         | 1831  | 10                             | 65       | 54        | 1                      | 2684                |
|                                 | Total     | 1078               | 207        | 2558  | 40                             | 373      | 761       | 77                     | 6228                |
| General population              | 0-14      | 188                | 48         | 110   | 19                             | 216      | 20        | 16                     | 883                 |
|                                 | 15-59     | 2388               | 487        | 972   | 53                             | 516      | 1512      | 122                    | 7070                |
|                                 | 60-69     | 717                | 56         | 469   | 16                             | 123      | 269       | 13                     | 1912                |
|                                 | 70-79     | 405                | 36         | 822   | 25                             | 91       | 168       | 6                      | 1864                |
|                                 | 80+       | 272                | 31         | 2828  | 22                             | 99       | 114       | 4                      | 4269                |
|                                 | Total     | 3970               | 659        | 5201  | 134                            | 1045     | 2083      | 162                    | 15998               |
| <b>Covid-19 Outbreak period</b> |           |                    |            |       |                                |          |           |                        |                     |



|    |            |       |      |     |      |    |     |      |    |       |
|----|------------|-------|------|-----|------|----|-----|------|----|-------|
| 1  |            |       |      |     |      |    |     |      |    |       |
| 2  |            |       |      |     |      |    |     |      |    |       |
| 3  |            |       |      |     |      |    |     |      |    |       |
| 4  |            |       |      |     |      |    |     |      |    |       |
| 5  | Male       | 0-14  | 77   | 13  | 55   | 4  | 118 | 22   | 8  | 398   |
| 6  |            | 15-59 | 1239 | 317 | 649  | 18 | 255 | 770  | 30 | 3904  |
| 7  |            | 60-69 | 408  | 51  | 304  | 10 | 46  | 146  | 4  | 1131  |
| 8  |            | 70-79 | 271  | 15  | 432  | 10 | 23  | 94   | 5  | 993   |
| 9  |            | 80+   | 135  | 18  | 997  | 14 | 27  | 32   | 3  | 1511  |
| 10 |            | Total | 2130 | 414 | 2437 | 57 | 469 | 1066 | 51 | 7937  |
| 11 | Female     | 0-14  | 50   | 18  | 46   | 5  | 33  | 23   | 6  | 247   |
| 12 |            | 15-59 | 370  | 108 | 174  | 11 | 80  | 401  | 28 | 1338  |
| 13 |            | 60-69 | 145  | 17  | 127  | 4  | 35  | 100  | 5  | 502   |
| 14 |            | 70-79 | 106  | 13  | 344  | 7  | 42  | 82   | 2  | 721   |
| 15 |            | 80+   | 70   | 20  | 1665 | 13 | 37  | 53   | 1  | 2441  |
| 16 |            | Total | 741  | 177 | 2356 | 41 | 226 | 660  | 43 | 5248  |
| 17 | General    | 0-14  | 127  | 31  | 100  | 9  | 151 | 46   | 14 | 644   |
| 18 | population | 15-59 | 1610 | 424 | 822  | 29 | 335 | 1171 | 59 | 5242  |
| 19 |            | 60-69 | 553  | 68  | 431  | 14 | 80  | 247  | 9  | 1633  |
| 20 |            | 70-79 | 377  | 28  | 776  | 17 | 65  | 177  | 7  | 1713  |
| 21 |            | 80+   | 205  | 39  | 2662 | 27 | 64  | 85   | 4  | 3953  |
| 22 |            | Total | 2871 | 591 | 4792 | 97 | 695 | 1725 | 93 | 13186 |
| 23 |            |       |      |     |      |    |     |      |    |       |
| 24 |            |       |      |     |      |    |     |      |    |       |
| 25 |            |       |      |     |      |    |     |      |    |       |
| 26 |            |       |      |     |      |    |     |      |    |       |
| 27 |            |       |      |     |      |    |     |      |    |       |
| 28 |            |       |      |     |      |    |     |      |    |       |
| 29 |            |       |      |     |      |    |     |      |    |       |
| 30 |            |       |      |     |      |    |     |      |    |       |
| 31 |            |       |      |     |      |    |     |      |    |       |
| 32 |            |       |      |     |      |    |     |      |    |       |
| 33 |            |       |      |     |      |    |     |      |    |       |
| 34 |            |       |      |     |      |    |     |      |    |       |
| 35 |            |       |      |     |      |    |     |      |    |       |
| 36 |            |       |      |     |      |    |     |      |    |       |
| 37 |            |       |      |     |      |    |     |      |    |       |
| 38 |            |       |      |     |      |    |     |      |    |       |
| 39 |            |       |      |     |      |    |     |      |    |       |
| 40 |            |       |      |     |      |    |     |      |    |       |
| 41 |            |       |      |     |      |    |     |      |    |       |
| 42 |            |       |      |     |      |    |     |      |    |       |
| 43 |            |       |      |     |      |    |     |      |    |       |
| 44 |            |       |      |     |      |    |     |      |    |       |
| 45 |            |       |      |     |      |    |     |      |    |       |
| 46 |            |       |      |     |      |    |     |      |    |       |

E-Table 5. Numbers for injury causes in 21 cities of Guangdong, China between the Covid-19 Outbreak and Control Period in 2019.

|           | Transport injuries     | Poisonings | Falls | Fire, heat, and hot substances | Drowning | Self-harm | Interpersonal violence | All injury |
|-----------|------------------------|------------|-------|--------------------------------|----------|-----------|------------------------|------------|
|           | Control Period in 2019 |            |       |                                |          |           |                        |            |
| Guangzhou | 312                    | 68         | 532   | 14                             | 71       | 351       | 28                     | 1889       |
| Shaoguan  | 187                    | 53         | 411   | 5                              | 50       | 92        | 4                      | 970        |
| Shenzhen  | 149                    | 30         | 120   | 2                              | 20       | 395       | 21                     | 827        |
| Zhuhai    | 50                     | 9          | 44    | 0                              | 16       | 47        | 6                      | 222        |
| Shantou   | 120                    | 19         | 211   | 7                              | 12       | 66        | 1                      | 496        |
| Foshan    | 230                    | 33         | 321   | 7                              | 82       | 105       | 6                      | 1053       |
| Jiangmen  | 233                    | 28         | 362   | 2                              | 90       | 93        | 7                      | 965        |
| Zhanjiang | 319                    | 37         | 273   | 10                             | 64       | 63        | 4                      | 966        |
| Maoming   | 297                    | 30         | 183   | 14                             | 85       | 78        | 4                      | 815        |
| Zhaoqing  | 207                    | 36         | 423   | 5                              | 64       | 62        | 6                      | 940        |
| Huizhou   | 246                    | 36         | 262   | 4                              | 67       | 100       | 19                     | 854        |
| Meizhou   | 202                    | 31         | 370   | 4                              | 55       | 71        | 6                      | 827        |
| Shanwei   | 89                     | 11         | 48    | 11                             | 15       | 29        | 4                      | 241        |
| Heyuan    | 129                    | 35         | 159   | 3                              | 37       | 43        | 0                      | 483        |
| Yangjiang | 145                    | 9          | 146   | 1                              | 23       | 34        | 5                      | 454        |

|    |           |      |     |      |     |      |      |     |       |
|----|-----------|------|-----|------|-----|------|------|-----|-------|
| 1  |           |      |     |      |     |      |      |     |       |
| 2  |           |      |     |      |     |      |      |     |       |
| 3  |           |      |     |      |     |      |      |     |       |
| 4  |           |      |     |      |     |      |      |     |       |
| 5  | Qingyuan  | 236  | 39  | 309  | 12  | 73   | 73   | 3   | 929   |
| 6  |           |      |     |      |     |      |      |     |       |
| 7  | Dongguan  | 202  | 59  | 257  | 6   | 69   | 170  | 29  | 933   |
| 8  |           |      |     |      |     |      |      |     |       |
| 9  | Zhongshan | 156  | 33  | 130  | 9   | 30   | 65   | 4   | 487   |
| 10 |           |      |     |      |     |      |      |     |       |
| 11 | Chaozhou  | 70   | 14  | 193  | 4   | 21   | 35   | 0   | 381   |
| 12 |           |      |     |      |     |      |      |     |       |
| 13 | Jieyang   | 233  | 31  | 243  | 4   | 60   | 66   | 2   | 705   |
| 14 |           |      |     |      |     |      |      |     |       |
| 15 | Yunfu     | 158  | 18  | 205  | 6   | 41   | 44   | 2   | 562   |
| 16 |           |      |     |      |     |      |      |     |       |
| 17 | Guangdong | 3970 | 659 | 5201 | 134 | 1045 | 2083 | 162 | 15998 |
| 18 |           |      |     |      |     |      |      |     |       |
| 19 |           |      |     |      |     |      |      |     |       |
| 20 |           |      |     |      |     |      |      |     |       |
| 21 |           |      |     |      |     |      |      |     |       |
| 22 |           |      |     |      |     |      |      |     |       |
| 23 |           |      |     |      |     |      |      |     |       |
| 24 |           |      |     |      |     |      |      |     |       |
| 25 |           |      |     |      |     |      |      |     |       |
| 26 |           |      |     |      |     |      |      |     |       |
| 27 |           |      |     |      |     |      |      |     |       |
| 28 |           |      |     |      |     |      |      |     |       |
| 29 |           |      |     |      |     |      |      |     |       |
| 30 |           |      |     |      |     |      |      |     |       |
| 31 |           |      |     |      |     |      |      |     |       |
| 32 |           |      |     |      |     |      |      |     |       |
| 33 |           |      |     |      |     |      |      |     |       |
| 34 |           |      |     |      |     |      |      |     |       |
| 35 |           |      |     |      |     |      |      |     |       |
| 36 |           |      |     |      |     |      |      |     |       |
| 37 |           |      |     |      |     |      |      |     |       |
| 38 |           |      |     |      |     |      |      |     |       |
| 39 |           |      |     |      |     |      |      |     |       |
| 40 |           |      |     |      |     |      |      |     |       |
| 41 |           |      |     |      |     |      |      |     |       |
| 42 |           |      |     |      |     |      |      |     |       |
| 43 |           |      |     |      |     |      |      |     |       |
| 44 |           |      |     |      |     |      |      |     |       |
| 45 |           |      |     |      |     |      |      |     |       |
| 46 |           |      |     |      |     |      |      |     |       |

---

**Covid-19 Outbreak period**


---

|    |           |     |    |     |    |    |     |    |      |
|----|-----------|-----|----|-----|----|----|-----|----|------|
| 19 | Guangzhou | 243 | 46 | 563 | 7  | 62 | 261 | 19 | 1633 |
| 20 |           |     |    |     |    |    |     |    |      |
| 21 | Shaoguan  | 147 | 45 | 315 | 1  | 32 | 58  | 1  | 712  |
| 22 |           |     |    |     |    |    |     |    |      |
| 23 | Shenzhen  | 45  | 17 | 69  | 0  | 7  | 274 | 7  | 485  |
| 24 |           |     |    |     |    |    |     |    |      |
| 25 | Zhuhai    | 48  | 18 | 61  | 3  | 17 | 59  | 4  | 261  |
| 26 |           |     |    |     |    |    |     |    |      |
| 27 | Shantou   | 84  | 17 | 201 | 3  | 24 | 44  | 2  | 444  |
| 28 |           |     |    |     |    |    |     |    |      |
| 29 | Foshan    | 183 | 32 | 281 | 6  | 48 | 94  | 2  | 851  |
| 30 |           |     |    |     |    |    |     |    |      |
| 31 | Jiangmen  | 216 | 17 | 350 | 6  | 49 | 77  | 5  | 845  |
| 32 |           |     |    |     |    |    |     |    |      |
| 33 | Zhanjiang | 240 | 30 | 211 | 18 | 52 | 51  | 1  | 726  |
| 34 |           |     |    |     |    |    |     |    |      |
| 35 | Maoming   | 212 | 22 | 156 | 8  | 56 | 67  | 6  | 603  |
| 36 |           |     |    |     |    |    |     |    |      |
| 37 | Zhaoqing  | 124 | 19 | 421 | 4  | 30 | 65  | 7  | 778  |
| 38 |           |     |    |     |    |    |     |    |      |
| 39 | Huizhou   | 137 | 30 | 230 | 3  | 39 | 55  | 9  | 620  |

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

|           |      |     |      |    |     |      |    |       |
|-----------|------|-----|------|----|-----|------|----|-------|
| Meizhou   | 158  | 51  | 351  | 6  | 56  | 86   | 1  | 816   |
| Shanwei   | 39   | 11  | 31   | 0  | 12  | 23   | 0  | 140   |
| Heyuan    | 91   | 36  | 183  | 4  | 20  | 42   | 0  | 429   |
| Yangjiang | 97   | 21  | 116  | 2  | 25  | 43   | 5  | 369   |
| Qingyuan  | 214  | 55  | 364  | 6  | 44  | 62   | 3  | 937   |
| Dongguan  | 181  | 33  | 213  | 4  | 31  | 144  | 11 | 770   |
| Zhongshan | 94   | 18  | 132  | 2  | 19  | 82   | 1  | 403   |
| Chaozhou  | 75   | 14  | 193  | 3  | 11  | 23   | 1  | 364   |
| Jieyang   | 151  | 36  | 178  | 3  | 49  | 81   | 2  | 581   |
| Yunfu     | 92   | 20  | 173  | 7  | 11  | 35   | 5  | 418   |
| Guangdong | 2871 | 591 | 4792 | 97 | 695 | 1725 | 93 | 13186 |

---

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

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

|                          |    |  |       |
|--------------------------|----|--|-------|
|                          |    | (b) Report category boundaries when continuous variables were categorized  | 7-8   |
|                          |    | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | 8     |
| Other analyses           | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | 8     |
| <b>Discussion</b>        |    |  |       |
| Key results              | 18 | Summarise key results with reference to study objectives   | 8-11  |
| Limitations              | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias                 | 11    |
| Interpretation           | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 10-11 |
| Generalisability         | 21 | Discuss the generalisability (external validity) of the study results  | 11    |
| <b>Other information</b> |    |  |       |
| Funding                  | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based              |       |

\*Give information separately for exposed and unexposed groups.

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

# BMJ Open

## Trends of injury mortality during the COVID-19 period in Guangdong, China: A population-based retrospective analysis

|                                 |   |
|---------------------------------|---|
| Journal:                        | <i>BMJ Open</i>   |
| Manuscript ID                   | bmjopen-2020-045317.R2  |
| Article Type:                   | Original research   |
| Date Submitted by the Author:   | 18-Jan-2021   |
| Complete List of Authors:       | Zheng, Xue-yan; Guangdong provincial center for disease control and prevention<br>Tang, Si-li; Southern Medical University, School of Public Health<br>Ma, Shu-li; Guangdong Pharmaceutical University, Department of Epidemiology and Biostatistics<br>Guan, Wei-jie; First Affiliated Hospital of Guangzhou Medical College, State Key Laboratory of Respiratory Disease and National Clinical Research Center for Respiratory Disease<br>Xu, Xiaojun; Guangdong provincial center for disease control and prevention<br>Xu, Haofeng; Guangdong provincial center for disease control and prevention<br>Xu, Ying-shan; Guangdong provincial center for disease control and prevention<br>Xu, Yan-jun; Guangdong provincial center for disease control and prevention<br>Lin, Li-feng; Guangdong Center for Disease Control and Prevention |
| <b>Primary Subject Heading</b>: | Epidemiology  |
| Secondary Subject Heading:      | Public health   |
| Keywords:                       | EPIDEMIOLOGY, PUBLIC HEALTH, Suicide & self-harm < PSYCHIATRY   |
|                                 |   |

SCHOLARONE™  
Manuscripts



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

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

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



1  
2  
3  
4 **Trends of injury mortality during the COVID-19 period in Guangdong,**  
5  
6 **China: A population-based retrospective analysis**  
7

8 **Xue-yan Zheng<sup>1#</sup>, Si-li Tang<sup>1,2#</sup>, Shu-li Ma<sup>1,3#</sup>, Wei-jie Guan<sup>4#</sup>, Xiao-jun Xu<sup>1</sup>, Hao-feng**  
9 **Xu<sup>1</sup>, Ying-shan Xu<sup>1</sup>, Yan-jun Xu<sup>1\*</sup>, Li-feng Lin<sup>1,2\*</sup>**  
10

11  
12 1 Guangdong provincial center for disease control and prevention, Guangdong, China.

13  
14 2 School of Public Health, Southern Medical University, Guangdong, China

15  
16 3 Department of Epidemiology and Biostatistics, School of Public Health, Guangdong  
17  
18 Pharmaceutical University, Guangzhou, China.

19  
20 4 State Key Laboratory of Respiratory Disease and National Clinical Research Center  
21  
22 for Respiratory Disease, the First Affiliated Hospital of Guangzhou Medical  
23  
24 University, Guangzhou Medical University, Guangzhou, China.  
25

26  
27  
28 **# Xue-yan Zheng, Si-li Tang, Shu-li Ma and Wei-jie Guan shared co-first authorship.**

29  
30 **\* Correspondence author 1: Li-feng Lin.** Guangdong provincial center for disease  
31  
32 control and prevention, Guangdong, China. Address: 160 Qunxian Road, Panyu district,  
33  
34 Guangzhou, Guangdong, China. Fax: 020-31051821, Phone: 020-31051821, E-mail:  
35  
36 [1396320174@qq.com](mailto:1396320174@qq.com).

37  
38 **Correspondence author 2: Yan-jun Xu.** Guangdong provincial center for disease  
39  
40 control and prevention, Guangdong, China. Address: 160 Qunxian Road, Panyu district,  
41  
42 Guangzhou, Guangdong, China. Fax: 020-31051492, Phone: 020-31051353, E-mail:  
43  
44 [759888406@qq.com](mailto:759888406@qq.com).

45  
46  
47  
48  
49  
50  
51  
52  
53  
54 Word count, excluding title page, abstract, references, figures and tables: 2365  
55  
56  
57  
58  
59  
60

## Abstract

**Objective:** We aimed to ascertain the trends of injury mortality during the COVID-19 period in southern China.

**Methods:** We conducted a population-based retrospective analysis to compare the mortality changes of all-cause injury and transport injuries, poisoning, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence, which were further stratified by sex and age. Comparisons were made between the COVID-19 period (between Jan 2020 and Jun 2020) and control period (between Jan 2019 and Jun 2019) in Guangdong province. We used the negative binomial models to explore the associations of deaths during the COVID-19 period, according to the different sex and age strata.

**Results:** The all-cause injury mortality in Guangdong province decreased significantly from 28.65 per 100,000 population during the control period to 23.24 per 100,000 population during COVID-19 pandemic period. Similar results were found in specific injury categories. Mortality of self-harm increased by 139.26% in the 10-14-year group during the COVID-19 period as compared with the control period. Although mortality changes in some groups were not statistically significant, some increases were noteworthy during the COVID-19 period (i.e. self-harm, transport injury and falls) in the 70-79-year group. The corresponding increase in mortality rate was 16.86%, 3.32% and 4.92%, respectively.

**Conclusion:** The mortality of all-cause injury, transport injury and drowning during the COVID-19 pandemic was consistently decreased. However, the increase in mortality associated with falls, fire/heat/hot substance injury and self-harm in specific age populations warrant the targeted control and prevention measures for the population at risk.

**Key Words:** Injury; Mortality; COVID-19

### Strengths and limitations of this study

1. This is the first study comparing the injury mortality between the COVID-19 period and the control period.
2. The completeness of death surveillance in Guangdong province was estimated using an empirical method to minimize under-reporting.
3. The causative effect of the COVID-19 epidemic on injury mortality could not be confirmed due to the limitation of the observational study design.
4. There was a lack of injury incidence, which should be regarded as another limitation of measuring the injury-associated burden.

## Introduction

During the coronavirus disease 2019 (COVID-19) pandemic, strict quarantine measures have been introduced to curb the transmission of severe acute respiratory syndrome coronavirus-2 in mainland China, including the people who have not contracted the COVID-19 patients [1]. Guangdong is a major province which has suffered from one of the major massive epidemics of COVID-19 in mainland China. The government had enforced stringent quarantine and lockdown measures with an unprecedented effort to contain the COVID-19 outbreak. Except for those who were responsible for providing the daily necessities and emergency services, the workforce has ceased working since the Chinese Lunar Calendar New Year (January 24th, 2020) and were requested to return to work after February 10<sup>th</sup>, 2020. COVID-19 has also markedly dampened the global social orders and economy [2].

Recent studies have showed that the COVID-19 pandemic confers a profound effect on all aspects of the society which has been extended to the mental health. Significant decreases in the rate of acute coronary syndrome-related hospitalization and out-patient visits have been reported in Italy during the early COVID-19 outbreak [3-4]. The projected increases in suicide have also been linked to the COVID-19 outbreak in Canada [5]. The vicarious traumatization scores of the general public have recently been shown to be significantly higher than those of the front-line nurses [6]. Different levels of psychological impacts (including stress, anxiety and depression) might have accounted for the increase in the suicidal events. Multidisciplinary research priorities for the COVID-19 pandemic have called for an urgent action for mental health science [7].

Guangdong province has 108 million permanent residents that account for 8.03% of the population in mainland China. Twenty-one cities with 122 counties are located in Guangdong province. Compared with other provinces, Guangdong has achieved the highest gross domestic product and become the most developed province with the largest population in southern China. Currently, little is known about the mortality changes of injury (including suicide) in different age and sex strata during the COVID-19 period in southern China.

1  
2  
3  
4 We hypothesized that there would be both physical and mental health issues  
5 caused by the lockdown and quarantine measures during the COVID-19 period. We  
6 sought to ascertain the injury mortality changes in Guangdong province. Our findings  
7 might help provide the evidence about the *status quo* of injury and mental health, as  
8 well as the guidance and actionable information for governments and public health  
9 authorities during the COVID-19 pandemic.  
10  
11  
12  
13  
14  
15  
16

## 17 **Methods and material**

### 18 ***Study design and data source***

19 We conducted a population-based retrospective analysis to compare the mortality  
20 changes of injury in different categories (including transport injuries, poisonings, falls,  
21 fire/heat/hot substances, drowning, self-harm and interpersonal violence, which were  
22 stratified by sex and age) between the study and control period. The study period was  
23 defined as the duration between the date of the identification of the first cases and  
24 the date when quarantine measures were implemented in Guangdong province  
25 (January 1st 2020) and the data cut-off (June 30<sup>th</sup> 2020). The control period was  
26 defined as a corresponding period during the previous year (from January 1st 2019 to  
27 June 30<sup>th</sup> 2019). Death registration is an all-cause of death surveillance which covers  
28 the whole population residing in Guangdong province. Mortality data were derived  
29 from the Chinese Center for Disease Control and Prevention (CDC) Cause of Death  
30 Reporting System [8].  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43

### 44 ***Definition of major injury category***

45 Injury deaths were identified according to the ICD-10 codes as recommended by the  
46 US CDC [9-10], based on the diagnostic codes of V01-Y89. Based on published studies  
47 and the ICD-10 codes of injury, we selected several categories of injury: transport  
48 injuries (V01-V04,V06,V09-V80,V87,V89,V99), poisonings (X40-X49), falls (W00-W19),  
49 fire, heat, and hot substances (X00-X09), drowning (W65-W74), self-harm (X60-  
50 X84,Y87.0), and interpersonal violence (X85-Y09,Y87.1).  
51  
52  
53  
54  
55  
56  
57

### 58 ***Statistical analyses***

59 The registered population number in different age and sex strata in both 2019 and  
60

2020 that corresponded to different cities in Guangdong province were obtained from the Population Basic Information System, which served as the denominators for mortality calculation. The percentage changes were calculated with the following formula:

$$\frac{\text{Mortality in COVID-19 period} - \text{Mortality in control period in 2019}}{\text{Mortality in control period in 2019}} \times 100\%$$

The completeness of death surveillance in Guangdong province was estimated empirically [11]. Briefly, the following equation was applied to predict the completeness for both sexes:

$$\text{logit}(C^{\text{All}}) = (\text{RegCDR}_{\text{sq}} \times -0.0238) + (\text{RegCDR} \times 0.8419) + (\%65 \times -19.6118) + (\ln(5q0) \times -1.5135) + (\text{Year} \times -0.0251) + 44.3755 + \gamma$$

where  $C^{\text{All}}$  was the completeness of the registration of all ages,  $\text{logit}(C^{\text{All}})$  equaled

to  $\ln\left(\frac{C^{\text{All}}}{1-C^{\text{All}}}\right)$ ,  $\text{RegCDR}$  was the registered crude death rate (CDR),  $\text{RegCDR}_{\text{sq}}$

was the square of  $\text{RegCDR}$ ,  $\%65$  was the fraction of the population aged 65 years or greater,  $\ln(5q0)$  was the natural log of the under-5 mortality rate,  $\text{Year}$  was calendar year,  $\gamma$  was a random effect. The predicted completeness was converted by using the

inverse logit: 
$$\frac{e^{\text{logit}(C^{\text{All}})}}{e^{\text{logit}(C^{\text{All}})} + 1}$$

Because of the overdispersion of injury deaths, we used negative binomial models to explore the associations of deaths within the COVID-19 period in different sex and age strata [12-13]. All statistical analyses were conducted using Stata statistical software version 12.1. Differences were considered statistically significant in the 2-tailed tests if the p-values were less than 0.05.

### ***Patient and Public Involvement***

No patient involved

### **Results**

The completeness was 97.03% and 98.53% based on the empirical estimation,

respectively. The all-cause injury mortality in Guangdong province decreased from 28.65 per 100,000 population in the control period to 23.24 per 100,000 people in the COVID-19 pandemic ( $P < 0.05$ ). Furthermore, the mortality of specific injury categories including transport injuries (5.06 per 100,000 population vs. 7.11 per 100,000 population), poisonings (1.04 per 100,000 population vs. 1.18 per 100,000 population), falls (8.45 per 100,000 population vs. 9.31 per 100,000 population), fire, heat, and hot substances (0.17 per 100,000 population vs. 0.24 per 100,000 population), drowning (1.23 per 100,000 population vs. 1.87 per 100,000 population), self-harm (3.04 per 100,000 population vs. 3.73 per 100,000 population), interpersonal violence (0.16 per 100,000 population vs. 0.29 per 100,000 population) decreased significantly during the COVID-19 pandemic as compared with the control period. (All  $P < 0.05$ , **Table 1**, **Figure 1**)

**Table 1. Comparison of mortality for injury causes between the onset of the Covid-19 Outbreak and the control period in Guangdong province**

| Injury subtypes                | Study period (1/100000) | Control period (1/100000) | Changes (%) | P        |
|--------------------------------|-------------------------|---------------------------|-------------|----------|
| All cause of injury            | 23.24                   | 28.65                     | -18.86      | < 0.0001 |
| Transport injuries             | 5.06                    | 7.11                      | -28.80      | < 0.0001 |
| Poisonings                     | 1.04                    | 1.18                      | -11.71      | 0.028    |
| Falls                          | 8.45                    | 9.31                      | -9.30       | < 0.0001 |
| Fire, heat, and hot substances | 0.17                    | 0.24                      | -28.41      | 0.012    |
| Drowning                       | 1.23                    | 1.87                      | -34.51      | < 0.0001 |
| Self-harm                      | 3.04                    | 3.73                      | -18.46      | < 0.0001 |
| Interpersonal violence         | 0.16                    | 0.29                      | -43.19      | < 0.0001 |

The mortality from all-cause and specific category injuries (including transport injuries, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence) decreased significantly in the total population and in both males and females, with exception of heat and hot substances in females (**Table 2**, **Figure 2**). Stratification of the study population into different age strata revealed a significantly increased

mortality. The self-harm mortality in the 10-14-year group significantly increased in males, females and the general population. Although the increased mortality of self-harm, transport injury, falls and interpersonal violence in the 70-79-year group did not reach statistical significance, the increase in mortality in this age group was noteworthy. Moreover, there was an insignificant increase in mortality from fire, heat, and hot substances in the 80+-year group in both sexes as well as from falls in the 80+-year group among males. (Table 2, Figure 3)

The number of deaths due to all-cause injuries and specific types of injuries in different age groups and cities are provided in the online supplementary material. (E-Table 1-3)

**Table 2. Mortality changes (%) in injury causes between the Covid-19 Outbreak and Control Period in different age groups of males and females in Guangdong.**

| Sex strata | Age group | Transport injuries | Poisonings | Falls   | Fire, heat, and hot substances | Drowning    | Self-harm                | Interpersonal violence | All-cause of injury |
|------------|-----------|--------------------|------------|---------|--------------------------------|-------------|--------------------------|------------------------|---------------------|
| Male       | 0-14      | -32.25*            | -39.30     | -13.19  | -69.83*                        | -19.32      | 151.49*<br>(10-14 years) | 56.90                  | -<br>22.50*         |
|            | 15-59     | -31.56*            | -10.15     | -16.89* | -48.01*                        | -<br>32.84* | -24.25*                  | -55.36*                | -<br>25.99*         |
|            | 60-69     | -35.86*            | 3.30       | -27.63* | -42.45                         | -<br>45.88* | -19.98                   | -35.54                 | -<br>29.49*         |
|            | 70-79     | 7.44               | -0.94      | 6.75    | -40.91                         | -<br>41.31* | 21.41                    | 87.11                  | 2.71                |
|            | 80+       | -13.68             | -6.54      | 5.45    | 32.16                          | -15.04      | -43.68*                  | 3.84                   | 0.53                |
|            | Total     | -27.06*            | -9.16      | -8.72*  | -39.99*                        | -<br>30.90* | -20.19*                  | -40.54*                | -<br>19.56*         |
| Female     | 0-14      | -36.34*            | -35.24     | -8.50   | -6.46                          | -<br>55.27* | 127.00*<br>(10-14 years) | -48.98                 | -<br>37.04*         |
|            | 15-59     | -36.42*            | -20.97     | -10.48  | -36.32                         | -<br>41.98* | -19.51*                  | -47.01*                | -<br>26.13*         |
|            | 60-69     | -43.33*            | -14.22     | -21.81  | 51.38                          | -<br>50.51* | -35.40*                  | -52.69                 | -<br>35.63*         |
|            | 70-79     | -2.53              | -22.83     | 3.49    | 49.58                          | -0.44       | 12.40                    | -28.77                 | 2.51                |
|            | 80+       | -33.09*            | 101.69     | -6.87*  | 31.10                          | -           | 0.85                     | 0.85                   | -6.86*              |



|                    |       |         |         |         |         |        |               |         |        |
|--------------------|-------|---------|---------|---------|---------|--------|---------------|---------|--------|
|                    |       |         |         |         |         | 42.37* |               |         |        |
|                    | Total | -32.78* | -16.62  | -9.93*  | -1.21   | -      | -15.17*       | -46.06* | -      |
|                    |       |         |         |         |         | 40.67* |               |         | 17.58* |
|                    |       |         |         |         |         |        | 139.26*       |         |        |
| General population | 0-14  | -34.07* | -36.68* | -11.18  | -52.00  | -      | (10-14 years) | -16.00  | -      |
| n                  | 15-59 | -32.71* | -13.13* | -15.56* | -44.10* | 31.89* |               |         | 28.87* |
|                    | 60-69 | -38.81* | -3.04   | -27.01* | -31.62  | -      | -22.67*       | -51.68* | -      |
|                    | 70-79 | 3.32    | -12.44  | 4.92    | -22.48  | 35.25* | -27.24*       | -45.90  | 25.99* |
|                    | 80+   | -21.92  | 29.26   | -2.45   | 31.20   | -      | 16.83         | 27.69   | 2.12   |
|                    | Total | -28.80* | -11.71* | -9.30*  | -28.41* | 33.03* | -22.78        | 2.05    | -4.04  |
|                    |       |         |         |         |         | -      | -18.46*       | -43.19* | -      |
|                    |       |         |         |         |         | 34.51* |               |         | 18.86* |

\*: statistical significance using negative binomial model for comparison of COVID-19 period and control period in 2019 (P< 0.05)

## Discussion

Our study revealed that the mortality from all-cause injury and specific categories of injury (including transport injuries, poisonings, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence) has decreased dramatically, which might have resulted from the COVID-19 pandemic. However, stratification of the study population into different city, age and sex strata has unraveled a significantly increased mortality in certain types of injury. Despite that the mortality changes in some strata did not reach statistical significance, there has been a notably increased mortality during the COVID-19 period (i.e. self-harm, transport injury, falls, interpersonal violence in the 70-79 year group). This has shed light on the priorities and longer-term strategies for injury and mental health scientific research, control and prevention. To our knowledge, this is the first study that demonstrated the injury mortality at different age and sex strata at the provincial level in mainland China. Our findings have added new insights by providing comparisons between the COVID-19 pandemic period and the control period in 2019.

Because our study was conducted during the COVID-19 pandemic when stringent lockdown and quarantine measures were enforced in mainland China, the most

1  
2  
3  
4 prominent impact of COVID-19 on injury could not be fully captured. During the  
5 COVID-19 outbreak, most people avoided outdoor activities to minimize the use of  
6 healthcare services and avoid the contract of SARS-CoV-2 infection. Consequently,  
7 there has been a notable decrease in the mortality from transport injury and drowning  
8 at all age strata. Similar results have been documented in the UK [14] and India [15].  
9 Degenerative spine and traumatic brain injuries also decreased significantly during the  
10 COVID-19 pandemic in UK [14]. The lockdown has grossly decreased the disability-  
11 adjusted life years caused by road traffic injury [15].  
12  
13  
14  
15  
16  
17  
18

19 It remains unclear why the mortality of fire, heat, and hot substances in the  
20 general population decreased during the COVID-19 period based on the existing data  
21 and literature reports. In line with our study, some researchers have demonstrated a  
22 higher mortality in the elderly [16-17]. In the UK, scalds accounted for 60% of the  
23 deaths of fire, heat, and hot substances in the >75-year group [18]. By contrast to the  
24 findings from the previous study, fire or smoke inhalation caused by fire are the main  
25 causes of the increased mortality among the elderly during the COVID-19 period in our  
26 study. People who died from fire, heat and hot substances were reported from the  
27 rural areas, where the elderly living alone were more likely to use biomass fuel (i.e.,  
28 wood, coal, animal dung, crop residues) for cooking and heating. A comprehensive  
29 strategy that integrates public education, distribution of firefighting equipment,  
30 adequate supervision for the vulnerable adults while heating and cooking and the use  
31 of aging electric appliance in the elderly would be indispensable to improve public  
32 health.  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45

46 The causes of death from interpersonal violence have been multifactorial.  
47 Theoretically, unemployment and fear of acquiring COVID-19 would have predisposed  
48 to an increased incidence of household interpersonal violence that has been non-fatal.  
49 By contrast, both the incidence and mortality of social interpersonal violence would  
50 sharply decrease because of the stringent lockdown and quarantine measures which  
51 might have been fatal. The decrease in the mortality associated with social  
52 interpersonal violence might have largely been offset by the non-fatal incidence of  
53 household interpersonal violence.  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 The death rate of falls has been declining despite a notable increase in the elderly,  
5 which is probably due to the increased life expectancy in the past two decades. A  
6 greater proportion of the elderly living with chronic diseases were at risk of falls [19].  
7 This tended to be aggravated during the COVID-19 period because the elderly remain  
8 exposed to trauma due to domestic falls with a reduced number of health care  
9 services [20]. In this scenario, the elderly suffered from an increased risk of having  
10 disability or death due to the delayed care and treatment for fall-related injuries [21-  
11 22]. Given the relatively high burden of falls among the elderly, a systematic  
12 implementation to reduce the incidence of injuries from falls would be urgently  
13 needed. These measures include a sufficient medical and occupational therapy [23],  
14 professional environment hazard assessment and modification [24], vitamin D and  
15 calcium supplementation, hip protectors, reduction of many of the predisposing risk  
16 factors [25].

17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29 Self-harm is becoming a more pressing concern as the pandemic is spreading  
30 rapidly and has the longer-term effects on the general population, the economy, and  
31 the vulnerable population. The infectious disease epidemics seemed to serve as a  
32 catalyst to trigger the suicidal attempt of people with mental health disorders [26-27].  
33 Our results revealed an increased death rate for self-harm in the 10-14-year and 70-  
34 79-year group in both sexes. The likely adverse effects of the pandemic on children's  
35 mental health might be exacerbated by fear of being infected by SARS-CoV-2, self-  
36 isolation and physical distancing because of school closure [28]. These contributed to  
37 an increase in the prevalence of post-traumatic stress disorder symptoms, depression,  
38 anxiety and stress [29]. In conjunction with a higher risk of being exposed to the family  
39 conflicts, the household physical violence, academic stress and economic damage  
40 which were caused by the COVID-19 crisis might have collectively led to an increased  
41 rate of suicide among children [30]. A loss of employment, financial stressors and  
42 alcohol consumption, which have also been the well-recognized risk factors causing  
43 family conflict [31], might have aggravated during the lockdown. Despite of the mental  
44 health disorders and the family conflict, the elderly might be increasingly concerned  
45 because of the extraordinarily high case-fatality rate [32]. This might have also

1  
2  
3  
4 contributed to the increased risk of self-harm in the elderly. Selective and universal  
5 interventions are required for the targeted individuals at risk of suicide, including  
6 sharing the evidence-based interventions online, increasing volunteer workforce for  
7 crisis hot lines, providing financial safety nets for unemployment support [33]. Public  
8 health responses must ensure that those facing interpersonal violence are supported  
9 and that safe drinking messages are communicated, particularly for the bereaved  
10 individuals. Accessible health education and promotion for COVID-19 is recommended,  
11 because a study has reported that people who were proactively engaged in hand  
12 hygiene could have a decreased likelihood that the workforce experience psychiatric  
13 symptoms [29,34].  
14  
15  
16  
17  
18  
19  
20  
21  
22

23 Some limitations should be addressed. There was a lack of reliable injury  
24 incidence data. Therefore, the comparability of mortality data and incidence data due  
25 to the death registration completeness and coverage should be interpreted with  
26 caution. Although we have used an empirical method to minimize the  
27 underestimation in the death surveillance, the magnitude of completeness of the  
28 mortality data varied considerably for children and adult deaths based on the GBD  
29 2010 study's finding [35]. The completeness of data in children was usually lower than  
30 that in adults in Latin America and Asia. Second, caution should also be exercised  
31 regarding the causative effect of the COVID-19 epidemic on injury mortality because  
32 of the limitation of the observational study design.  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42

43 Despite these limitations, our findings remained robust. The death registration is  
44 an all-cause death surveillance which covered all the population residing in  
45 Guangdong province. Data from the registration system in the recent years have been  
46 aligning well with the vital registration data that achieved a large increase in the  
47 coverage over the past decade [36].  
48  
49  
50  
51

52 In conclusion, the COVID-19 pandemic was associated with a decreased mortality  
53 of all injury, transport injury and drowning. However, the increase in the mortality of  
54 falls, fire, heat, and hot substances injury, self-harm in specific age populations during  
55 the COVID-19 period still warrant the targeted and universal interventions for the  
56 mass public.  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 **Acknowledgement:** None.

7 **Contributors:** Xue-yan Zheng<sup>1#</sup>, Si-li Tang<sup>1,2#</sup>, Shu-li Ma<sup>1,3#</sup>, Xiao-jun Xu<sup>1</sup>, Hao-feng Xu,  
8 **Ying-shan Xu<sup>1</sup>, Yan-jun Xu<sup>1\*</sup>, Li-feng Lin**

9  
10  
11 Xiao-jun Xu, Hao-feng Xu, Ying-shan Xu, Yan-jun Xu and Li-feng Lin conceived of the  
12 study and provided overall guidance. Xue-yan Zheng, Si-li Tang, Shu-li Ma, Wei-jie  
13 Guan and Li-feng Lin prepared the first draft and finalized the manuscript based on  
14 comments from all other authors and reviewer feedback. Xue-yan Zheng, Wei-jie  
15 Guan, Yan-jun Xu and Li-feng Lin played a key role in formulating the analysis. All other  
16 authors contributed to the analysis and reviewed the manuscript.  
17  
18  
19  
20  
21  
22

23 **Funding:** This research received no specific grant from any funding agency in the  
24 public, commercial or not-for-profit sectors.  
25  
26  
27  
28

29 **Competing interests:**

30 We declare no competing interests.  
31  
32  
33  
34

35 **Data availability statement**

36 All data relevant to the study are included in the article or uploaded as supplementary  
37 information  
38  
39  
40  
41  
42

43 **Reference:**

- 44 1. Hao F, Tan W, Jiang L, et al. Do psychiatric patients experience more psychiatric  
45 symptoms during COVID-19 pandemic and lockdown? A case-control study with  
46 service and research implications for immunopsychiatry. *Brain Behav Immun.*  
47 2020;87:100-106.  
48  
49 2. Gautam R, Sharma M. 2019-nCoV pandemic: A disruptive and stressful atmosphere  
50 for Indian academic fraternity. *Brain Behav Immun.* 2020;88:948-949.  
51 doi:10.1016/j.bbi.2020.04.025.  
52  
53 3. Baldi E, Sechi GM, Mare C, et al. Out-of-Hospital Cardiac Arrest during the Covid-19  
54 Outbreak in Italy. *N Engl J Med.* 2020;383(5):496-498.  
55  
56  
57  
58  
59  
60

- 1  
2  
3  
4 4. De Filippo O, D'Ascenzo F, Angelini F, et al. Reduced Rate of Hospital Admissions for  
5 ACS during Covid-19 Outbreak in Northern Italy. *N Engl J Med.* 2020;383(1):88-89.  
6
- 7 5. McIntyre RS, Lee Y. Projected increases in suicide in Canada as a consequence of  
8 COVID-19. *Psychiatry Res.* 2020;290:113104.  
9
- 10 6. Li Z, Ge J, Yang M, et al. Vicarious traumatization in the general public, members,  
11 and non-members of medical teams aiding in COVID-19 control. *Brain Behav Immun.*  
12 2020;88:916-919.  
13
- 14 7. Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for the  
15 COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry.*  
16 2020;7(6):547-560.  
17
- 18 8. Zhou M, Wang H, Zhu J, Chen W, Wang L, Liu S, et al. Cause-specific mortality for  
19 240 causes in China during 1990-2013: a systematic subnational analysis for the Global  
20 Burden of Disease Study 2013. *Lancet.* 2016 Jan 16;387(10015):251-72.  
21
- 22 9. Faul M, Xu L, Wald MM, Coronado VG. Traumatic brain injury in the United States:  
23 emergency department visits, hospitalizations and deaths 2002–2006. Atlanta: US  
24 Centers for Disease Control and Prevention; 2010.  
25
- 26 10. Thurman DJ, Snizek JE, Johnson D, Greenspan A, Smith SM. Guidelines for  
27 surveillance of central nervous system injury. Washington (DC): US Department of  
28 Health and Human Services; 1995.  
29
- 30 11. Adair T, Lopez AD. Estimating the completeness of death registration: An empirical  
31 method. *PLoS One.* 2018; 13(5):e0197047.  
32
- 33 12. Adams RS, Larson MJ, Corrigan JD, Ritter GA, Williams TV. Traumatic brain injury  
34 among U.S. active duty military personnel and negative drinking-related  
35 consequences. *Subst Use Misuse.* 2013; 48:821-36.  
36
- 37 13. Statistical Consulting Group. Negative binomial regression: Stata annotated output.  
38 Available from: [https://stats.idre.ucla.edu/stata/output/negative-binomial-](https://stats.idre.ucla.edu/stata/output/negative-binomial-regression/)  
39 [regression/](https://stats.idre.ucla.edu/stata/output/negative-binomial-regression/). Accessed 2017 Jun 1.  
40
- 41 14. Jayakumar N, Kennion O, Villabona AR, Paranathala M, Holliman D. Neurosurgical  
42 Referral Patterns During the Coronavirus Disease 2019 Pandemic: A United Kingdom  
43 Experience. *World Neurosurg.* 2020; 144:e414-e420.  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

15. Jain A, Goyal V, Varma C. Reflection of Epidemiological Impact on Burden of Injury in Tertiary Care Centre, Pre-COVID and COVID Era: "Lockdown, a Good Fortune for Saving Life and Limb". *Indian J Surg.* 2020; 24:1-5.
16. Sadeghian F, Saeedi Moghaddam S, Saadat S, et al. The trend of burn mortality in Iran - A study of fire, heat and hot substance-related fatal injuries from 1990 to 2015. *Burns.* 2019;45(1):228-240.
17. Tang K, Jian L, Qin Z, Zhenjiang L, Gomez M, Beveridge M. Characteristics of burn patients at a major burn center in Shanghai. *Burns* 2006;32: 1037-43.
18. Hussain A, Dunn K. Burn related mortality in Greater Manchester: 11-year review of Regional Coronial Department Data. *Burns.* 2015;41(2):225-234.
- 19 Centers for Disease Control and Prevention. Fatalities and injuries from falls among older adults, United States, 1993–2003 and 2001–2005. *MMWR Morb Mortal Wkly Rep* 2006; 55: 1221–24.
20. Gumina S, Proietti R, Polizzotti G, Carbone S, Candela V. The impact of COVID-19 on shoulder and elbow trauma: an Italian survey [published online ahead of print, 2020 May 20]. *J Shoulder Elbow Surg.* 2020; S1058-2746(20)30401-8.
21. Tong HJ, Huang CY. Changes of family structure and their social influence in contemporary China. *Xi Bei Ren Kou Za Zhi* 2015; 6: 81–84 (in Chinese).
22. Gao M, Li Y, Zhang S, et al. Does an empty nest affect elders' health? Empirical evidence from China. *Int J Environ Res Public Health* 2017; 14: E463.
23. Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. *Lancet.* 1999; 353(9147):93-97.
24. Keall MD, Pierse N, Howden-Chapman P, et al. Home modifications to reduce injuries from falls in the home injury prevention intervention (HIPI) study: a cluster-randomised controlled trial. *Lancet.* 2015;385(9964):231-238.
25. Kannus P, Sievänen H, Palvanen M, Järvinen T, Parkkari J. Prevention of falls and consequent injuries in elderly people. *Lancet.* 2005; 366(9500):1885-1893.
26. Wasserman IM. The impact of epidemic, war, prohibition and media on suicide: United States, 1910–1920. *Suicide Life Threat Behav* 1992; 22: 240–54.

- 1  
2  
3  
4 27. Cheung YT, Chau PH, Yip PS. A revisit on older adults suicides and severe acute  
5 respiratory syndrome (SARS) epidemic in Hong Kong. *Int J Geriatr Psychiatry* 2008; 23:  
6 1231–38.  
7  
8  
9 28. Yao H, Chen JH, Xu YF. Patients with mental health disorders in the COVID-19  
10 epidemic. *Lancet Psychiatry* 2020; 7: e21  
11  
12 29. Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general  
13 population during the COVID-19 epidemic in China. *Brain Behav Immun.* 2020;87:40-  
14 48.  
15  
16 30. Hoekstra PJ. Suicidality in children and adolescents: lessons to be learned from the  
17 COVID-19 crisis. *Eur Child Adolesc Psychiatry.* 2020;29(6):737-738.  
18  
19 31. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of  
20 economic crises and alternative policy responses in Europe: an empirical analysis.  
21 *Lancet* 2009; 374: 315-23.  
22  
23 32. Guan WJ, Liang WH, Zhao Y, et al. Comorbidity and its impact on 1590 patients  
24 with COVID-19 in China: a nationwide analysis. *Eur Respir J.* 2020;55(5):2000547.  
25  
26 33. Gunnell D, Appleby L, Arensman E, et al. Suicide risk and prevention during the  
27 COVID-19 pandemic. *Lancet Psychiatry.* 2020;7(6):468-471.  
28  
29 34. Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19  
30 pandemic stressful? A study on immediate mental health status and  
31 psychoneuroimmunity prevention measures of Chinese workforce. *Brain Behav*  
32 *Immun.* 2020;87:84-92.  
33  
34 35. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235  
35 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the  
36 Global Burden of Disease Study 2010. *Lancet* 2012;380:2095–128.  
37  
38 36 . GBD 2017 Mortality Collaborators. Global, regional, and national age- and  
39 sex-specific mortality and life expectancy for 195 countries and territories, 1950–2017:  
40 a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018;392:  
41 1684–735.  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



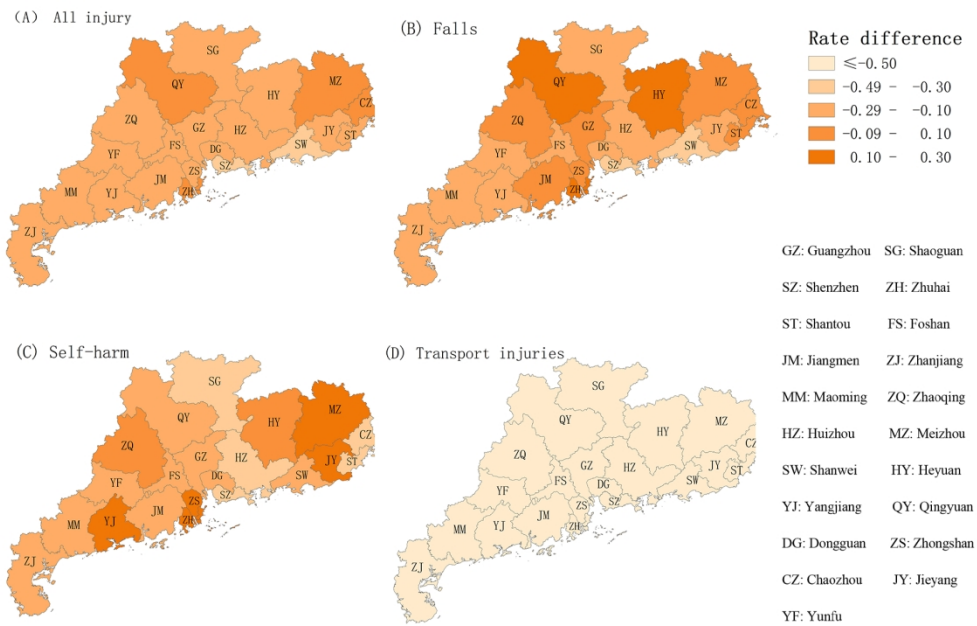
1  
2  
3  
4  
5  
6  
7  
8  
9 **Figure legends:**  
10

11  
12  
13 Figure 1. All injury, transport injuries, falls and self-harm mortality changes between  
14 the Covid-19 pandemic period and control period in 21 cities in Guangdong province,  
15  
16 China.

17  
18 GZ: Guangzhou; SG: Shaoguan; SZ: Shenzhen; ZH: Zhuhai; ST: Shantou; FS: Foshan; JM:  
19 Jiangmen; ZJ: Zhanjiang; MM: Maoming; ZQ: Zhaoqing; HZ: Huizhou; MZ: Meizhou; SW:  
20 Shanwei; HY: Heyuan; YJ: Yangjiang; QY: Qingyuan; DG: Dongguan; ZS: Zhongshan; CZ:  
21 Chaozhou; JY: Jieyang; YF: Yunfu.  
22  
23  
24  
25  
26  
27

28  
29 Figure 2. All injury, transport injuries, falls and self-harm in different sex groups  
30 between the Covid-19 pandemic period and control period in Guangdong province,  
31  
32 China.  
33  
34  
35

36  
37 Figure 3. All injury, transport injuries, falls and self-harm mortality changes in different  
38 age and sex groups between the Covid-19 pandemic period and control period in  
39  
40 Guangdong province, China.  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



31 Figure 1. All injury, transport injuries, falls and self-harm mortality changes between the Covid-19 pandemic  
32 period and control period in 21 cities in Guangdong province, China.

33 160x119mm (300 x 300 DPI)

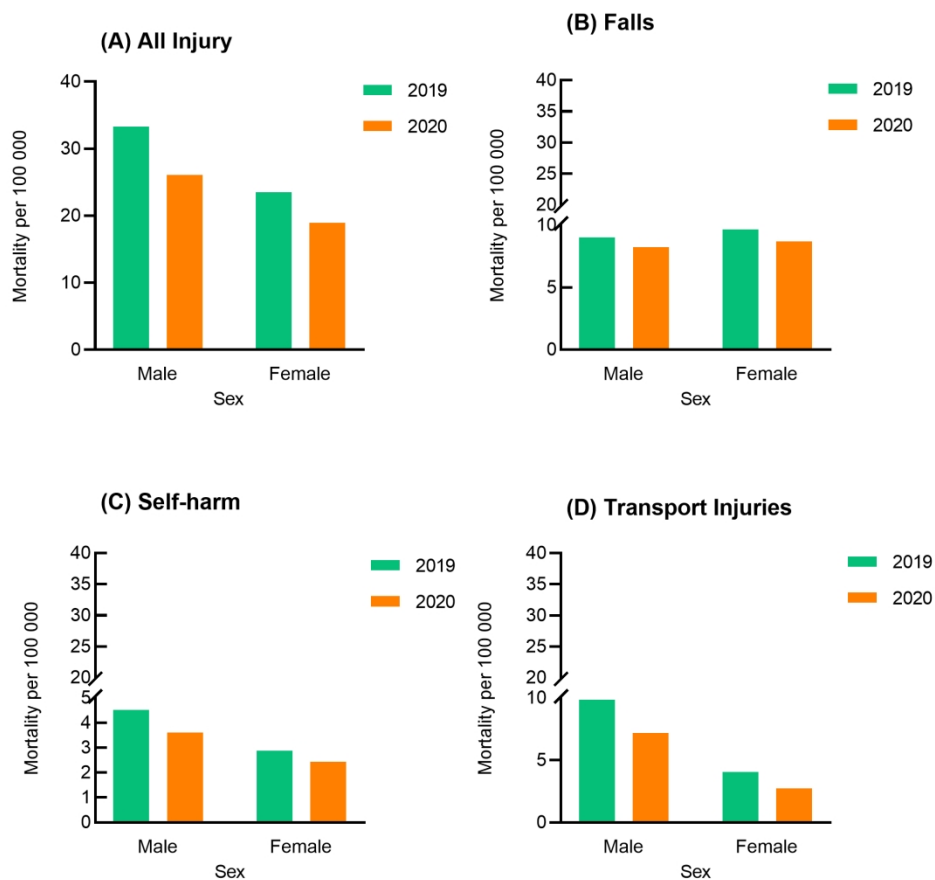


Figure 2. All injury, transport injuries, falls and self-harm in different sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

191x181mm (300 x 300 DPI)

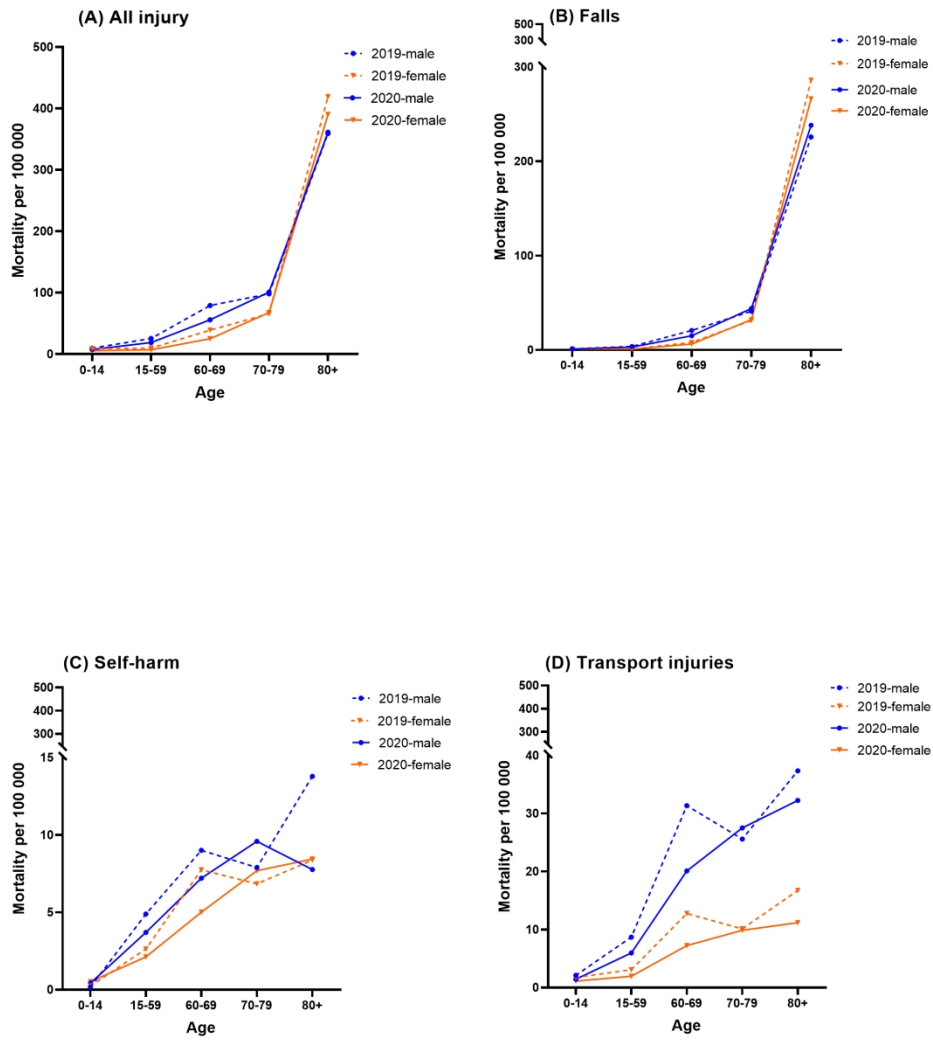


Figure 3. All injury, transport injuries, falls and self-harm mortality changes in different age and sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

198x216mm (300 x 300 DPI)

**E-Table 1. Mortality for injury causes in Guangdong, China between the Covid-19 Outbreak and Control Period in 2019 in different age groups in male and female population.**

| Sex group                     | Age group | Transport injuries | Poisonings | Falls  | Fire, heat, and hot substances | Drowning | Self-harm             | Interpersonal violence | All-cause of injury |
|-------------------------------|-----------|--------------------|------------|--------|--------------------------------|----------|-----------------------|------------------------|---------------------|
| <b>Control Period in 2019</b> |           |                    |            |        |                                |          |                       |                        |                     |
| Male                          | 0-14      | 2.12               | 0.41       | 1.18   | 0.25                           | 2.72     | 0.53<br>(10-14 years) | 0.1                    | 9.57                |
|                               | 15-59     | 8.7                | 1.69       | 3.75   | 0.17                           | 1.82     | 4.89                  | 0.33                   | 25.35               |
|                               | 60-69     | 31.36              | 2.42       | 20.74  | 0.87                           | 4.16     | 9                     | 0.31                   | 79.04               |
|                               | 70-79     | 25.61              | 1.56       | 41.12  | 1.74                           | 4.04     | 7.89                  | 0.28                   | 98.13               |
|                               | 80+       | 37.36              | 4.67       | 225.8  | 2.57                           | 7.71     | 13.78                 | 0.7                    | 359.13              |
|                               | Total     | 9.87               | 1.54       | 9.02   | 0.32                           | 2.29     | 4.51                  | 0.29                   | 33.33               |
| Female                        | 0-14      | 1.74               | 0.63       | 1.11   | 0.12                           | 1.66     | 0.76<br>(10-14 years) | 0.27                   | 8.71                |
|                               | 15-59     | 3.08               | 0.72       | 1.02   | 0.09                           | 0.73     | 2.63                  | 0.28                   | 9.57                |
|                               | 60-69     | 12.77              | 1          | 8.09   | 0.13                           | 3.48     | 7.75                  | 0.53                   | 38.9                |
|                               | 70-79     | 10.13              | 1.6        | 31.11  | 0.44                           | 3.91     | 6.84                  | 0.27                   | 65.77               |
|                               | 80+       | 16.73              | 1.61       | 285.89 | 1.61                           | 10.14    | 8.37                  | 0.16                   | 418.94              |
|                               | Total     | 4.06               | 0.78       | 9.64   | 0.15                           | 1.41     | 2.87                  | 0.29                   | 23.47               |
| General population            | 0-14      | 1.95               | 0.5        | 1.15   | 0.19                           | 2.25     | 0.63<br>(10-14 years) | 0.17                   | 9.19                |
|                               | 15-59     | 6.02               | 1.23       | 2.45   | 0.13                           | 1.3      | 3.81                  | 0.31                   | 17.82               |
|                               | 60-69     | 22.41              | 1.74       | 14.65  | 0.52                           | 3.83     | 8.4                   | 0.42                   | 59.71               |
|                               | 70-79     | 17.75              | 1.58       | 36.03  | 1.08                           | 3.97     | 7.36                  | 0.27                   | 81.69               |
|                               | 80+       | 25.15              | 2.86       | 261.38 | 2                              | 9.14     | 10.57                 | 0.38                   | 394.54              |

|                                 | Total | 7.11  | 1.18 | 9.31   | 0.24 | 1.87 | 3.73                  | 0.29 | 28.65  |
|---------------------------------|-------|-------|------|--------|------|------|-----------------------|------|--------|
| <b>Covid-19 Outbreak period</b> |       |       |      |        |      |      |                       |      |        |
| Male                            | 0-14  | 1.44  | 0.25 | 1.02   | 0.08 | 2.2  | 1.32<br>(10-14 years) | 0.15 | 7.42   |
|                                 | 15-59 | 5.96  | 1.52 | 3.12   | 0.09 | 1.22 | 3.7                   | 0.15 | 18.76  |
|                                 | 60-69 | 20.11 | 2.5  | 15.01  | 0.5  | 2.25 | 7.2                   | 0.2  | 55.74  |
|                                 | 70-79 | 27.52 | 1.55 | 43.9   | 1.03 | 2.37 | 9.58                  | 0.52 | 100.79 |
|                                 | 80+   | 32.25 | 4.36 | 238.11 | 3.39 | 6.55 | 7.76                  | 0.73 | 361.04 |
|                                 | Total | 7.2   | 1.4  | 8.23   | 0.19 | 1.58 | 3.6                   | 0.17 | 26.81  |
| Female                          | 0-14  | 1.11  | 0.41 | 1.02   | 0.11 | 0.74 | 1.73<br>(10-14 years) | 0.14 | 5.48   |
|                                 | 15-59 | 1.96  | 0.57 | 0.92   | 0.06 | 0.42 | 2.12                  | 0.15 | 7.07   |
|                                 | 60-69 | 7.24  | 0.86 | 6.32   | 0.2  | 1.72 | 5.01                  | 0.25 | 25.05  |
|                                 | 70-79 | 9.88  | 1.23 | 32.19  | 0.66 | 3.89 | 7.69                  | 0.19 | 67.42  |
|                                 | 80+   | 11.19 | 3.24 | 266.24 | 2.11 | 5.84 | 8.44                  | 0.16 | 390.2  |
|                                 | Total | 2.73  | 0.65 | 8.68   | 0.15 | 0.83 | 2.43                  | 0.16 | 19.35  |
| General population              | 0-14  | 1.29  | 0.32 | 1.02   | 0.09 | 1.53 | 1.50<br>(10-14 years) | 0.14 | 6.54   |
|                                 | 15-59 | 4.05  | 1.07 | 2.07   | 0.07 | 0.84 | 2.95                  | 0.15 | 13.19  |
|                                 | 60-69 | 13.71 | 1.69 | 10.69  | 0.35 | 1.99 | 6.11                  | 0.23 | 40.48  |
|                                 | 70-79 | 18.34 | 1.38 | 37.81  | 0.84 | 3.16 | 8.6                   | 0.35 | 83.42  |
|                                 | 80+   | 19.63 | 3.69 | 254.96 | 2.62 | 6.12 | 8.17                  | 0.39 | 378.6  |
|                                 | Total | 5.06  | 1.04 | 8.45   | 0.17 | 1.23 | 3.04                  | 0.16 | 23.24  |

**E-Table 2. Numbers for injury causes in Guangdong, China between the Onset of the COVID-19 outbreak and control Period in 2019.**

| Injury subtypes                   | Study period<br>(No.) | Control period<br>(No.) |
|-----------------------------------|-----------------------|-------------------------|
| All cause of injury               | 12858                 | 15988                   |
| Transport injuries                | 2871                  | 3978                    |
| Poisonings                        | 591                   | 667                     |
| Falls                             | 4792                  | 5209                    |
| Fire, heat, and hot<br>substances | 97                    | 134                     |
| Drowning                          | 695                   | 1053                    |
| Self-harm                         | 1725                  | 2093                    |
| Interpersonal violence            | 93                    | 162                     |

**E-Table 3. Numbers for injury causes in Guangdong, China between the Covid-19 Outbreak and Control Period in 2019 in different age groups in male and female population.**

| Sex group                     | Age group | Transport injuries | Poisonings | Falls | Fire, heat, and hot substances | Drowning | Self-harm           | Interpersonal violence | All-cause of injury |
|-------------------------------|-----------|--------------------|------------|-------|--------------------------------|----------|---------------------|------------------------|---------------------|
| <b>Control Period in 2019</b> |           |                    |            |       |                                |          |                     |                        |                     |
| Male                          | 0-14      | 113                | 22         | 63    | 13                             | 145      | 9<br>(10-14 years)  | 5                      | 511                 |
|                               | 15-59     | 1806               | 351        | 778   | 35                             | 378      | 1014                | 68                     | 5260                |
|                               | 60-69     | 520                | 40         | 344   | 14                             | 69       | 149                 | 5                      | 1312                |
|                               | 70-79     | 288                | 18         | 462   | 20                             | 45       | 89                  | 3                      | 1102                |
|                               | 80+       | 165                | 21         | 997   | 11                             | 34       | 61                  | 3                      | 1585                |
|                               | Total     | 2892               | 451        | 2644  | 94                             | 672      | 1322                | 85                     | 9770                |
| Female                        | 0-14      | 74                 | 27         | 47    | 5                              | 71       | 10<br>(10-14 years) | 11                     | 372                 |
|                               | 15-59     | 582                | 136        | 194   | 18                             | 138      | 498                 | 54                     | 1810                |
|                               | 60-69     | 197                | 15         | 125   | 2                              | 54       | 120                 | 8                      | 600                 |
|                               | 70-79     | 117                | 19         | 361   | 5                              | 45       | 79                  | 3                      | 763                 |
|                               | 80+       | 107                | 10         | 1831  | 10                             | 65       | 54                  | 1                      | 2684                |
|                               | Total     | 1078               | 207        | 2558  | 40                             | 373      | 761                 | 77                     | 6228                |
| General population            | 0-14      | 188                | 48         | 110   | 19                             | 216      | 20<br>(10-14 years) | 16                     | 883                 |
|                               | 15-59     | 2388               | 487        | 972   | 53                             | 516      | 1512                | 122                    | 7070                |
|                               | 60-69     | 717                | 56         | 469   | 16                             | 123      | 269                 | 13                     | 1912                |
|                               | 70-79     | 405                | 36         | 822   | 25                             | 91       | 168                 | 6                      | 1864                |
|                               | 80+       | 272                | 31         | 2828  | 22                             | 99       | 114                 | 4                      | 4269                |



|                                 |       | Total | 3970 | 659  | 5201 | 134 | 1045                | 2083 | 162   | 15998 |
|---------------------------------|-------|-------|------|------|------|-----|---------------------|------|-------|-------|
| <b>Covid-19 Outbreak period</b> |       |       |      |      |      |     |                     |      |       |       |
| Male                            | 0-14  | 77    | 13   | 55   | 4    | 118 | 22<br>(10-14 years) | 8    | 398   |       |
|                                 | 15-59 | 1239  | 317  | 649  | 18   | 255 | 770                 | 30   | 3904  |       |
|                                 | 60-69 | 408   | 51   | 304  | 10   | 46  | 146                 | 4    | 1131  |       |
|                                 | 70-79 | 271   | 15   | 432  | 10   | 23  | 94                  | 5    | 993   |       |
|                                 | 80+   | 135   | 18   | 997  | 14   | 27  | 32                  | 3    | 1511  |       |
|                                 | Total | 2130  | 414  | 2437 | 57   | 469 | 1066                | 51   | 7937  |       |
| Female                          | 0-14  | 50    | 18   | 46   | 5    | 33  | 23<br>(10-14 years) | 6    | 247   |       |
|                                 | 15-59 | 370   | 108  | 174  | 11   | 80  | 401                 | 28   | 1338  |       |
|                                 | 60-69 | 145   | 17   | 127  | 4    | 35  | 100                 | 5    | 502   |       |
|                                 | 70-79 | 106   | 13   | 344  | 7    | 42  | 82                  | 2    | 721   |       |
|                                 | 80+   | 70    | 20   | 1665 | 13   | 37  | 53                  | 1    | 2441  |       |
|                                 | Total | 741   | 177  | 2356 | 41   | 226 | 660                 | 43   | 5248  |       |
| General population              | 0-14  | 127   | 31   | 100  | 9    | 151 | 46<br>(10-14 years) | 14   | 644   |       |
|                                 | 15-59 | 1610  | 424  | 822  | 29   | 335 | 1171                | 59   | 5242  |       |
|                                 | 60-69 | 553   | 68   | 431  | 14   | 80  | 247                 | 9    | 1633  |       |
|                                 | 70-79 | 377   | 28   | 776  | 17   | 65  | 177                 | 7    | 1713  |       |
|                                 | 80+   | 205   | 39   | 2662 | 27   | 64  | 85                  | 4    | 3953  |       |
|                                 | Total | 2871  | 591  | 4792 | 97   | 695 | 1725                | 93   | 13186 |       |

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

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

|                          |    |  |       |
|--------------------------|----|--|-------|
|                          |    | (b) Report category boundaries when continuous variables were categorized  | 7-8   |
|                          |    | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | 8     |
| Other analyses           | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | 8     |
| <b>Discussion</b>        |    |  |       |
| Key results              | 18 | Summarise key results with reference to study objectives   | 8-11  |
| Limitations              | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias                 | 11    |
| Interpretation           | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 10-11 |
| Generalisability         | 21 | Discuss the generalisability (external validity) of the study results  | 11    |
| <b>Other information</b> |    |  |       |
| Funding                  | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based              |       |

\*Give information separately for exposed and unexposed groups.

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