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

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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.

Key Words: Injury; Mortality; COVID-19

Strengths and limitations of this study

1. This is the first study to demonstrate multiple injury mortality at different age and sex population at provincial level in China, making comparisons between COVID-19 pandemic period and control period.
2. The total and lower categories of injury mortality in Guangdong province decreased significantly in COVID-19 pandemic period, when comparing with 2019 control period.
3. Mortality changes of self-harm had statistically significant increase in 0-14 age groups.
4. The causative effect of the COVID-19 epidemic on injury mortality was limited owning to the limitation of the observational study, and the lack of injury incidence data.

Introduction

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

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

Guangdong province has 108 million permanent residents that account for 8.03% of the population in China. Compared with other provinces, Guangdong has achieved the highest gross domestic product, and become the most leading 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 group during COVID-19 period in southern China, even in Guangdong province. This might help provide evidence about the situation of injury and metal health

problem at this scenario; guidance and actionable information for governments and public health authorities at the pandemic period. To solve the gap, we conducted this population-based retrospective study to ascertain the injury mortality changes at the COVID-19 period in Guangdong, China.

Methods and material

Study design and data source

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

Definition of major injury category

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

Statistical analyses

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

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

where C^{All} is the completeness of registration at all ages, $\log it\left(C^{All}\right)$ is $\ln\left(\frac{\text{C}^{\text{All}}}{1-\text{C}^{\text{All}}}\right)$, $RegCDR$ 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, $\ln\left(5q0\right)$ is the natural log of the under-5 mortality rate, *Year* is calendar year, *γ* is a random effect, Predicted completeness is converted using the inverse logit: $\frac{e^{\text{logit}\left(C^{All}\right)}}{e^{\text{logit}\left(C^{All}\right)}+1}$

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**)

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

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

Except for the increase death rate of Zhuhai (9.89%) and Qingyuan (0.52%), death rate of all injuries in 11 cities decreased significantly in Guangdong during COVID-19 period when comparing with control period in 2019. Mortality of transport injuries in 17 cities in Guangdong declined significantly in COVID-19 period, decreased rate falling from 11.82% people in Zhuhai to 71.26% in Shenzhen. Decreased death rate from falls fell from -0.16% to -44.48% in 16 cities in Guangdong, while mortalities increased from 0.07% to 28.28% in five cities including Guangzhou, Zhuhai, Heyuan, Qingyuan and Zhongshan. Self-harm mortality increased from 4.12% to 24.71% in Zhuhai, Zhaoqing, Meizhou, Yangjiang, Zhongshan and Jieyang in COVID-19 period, while reduced self-harm mortalities were reported in other cities. (**E-Table 1, Figure 1**)

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

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

Table2. Mortality changes 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
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*

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

Discussion

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

transport injuries, poisonings, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence decreased and benefited from the COVID-19 pandemic. However, when dividing the population into different city, age and sex groups, some statistical significant increased mortalities could be found in specific injury categories. Though mortality changes in some groups did not have statistical significances, increased mortalities were noteworthy, i.e. self-harm, transport injury, falls, interpersonal violence in 70-79 age group. This provide a priorities and longer-term strategies for injury and mental health science research, control and prevention. Based on our best knowledge, this is the first study that conducted to demonstrate multiple injury mortality at different age and sex population at provincial level in China, making comparisons between COVID-19 pandemic period and control period in 2019.

We have make big progress in improvements in road construction, expansion of road safety awareness, increased motor vehicle safety systems and establishment in road safety laws, annual drownings warnings from Ministry of Education, improved infrastructure projects to decrease exposure to bodies of water during these years. This might contribute in decreasing in transport injury [13] and drowning [14-15] mortality. As this study conducted at the time when China was facing the COVID-19 pandemic and imposed lockdown and quarantine measures, the full impact of COVID-19 on injury at its peak would be captured. During the COVID-19 outbreak and the outcomes of isolation and quarantine, most people were avoiding going out to reduce the chance of infecting with COVID-19 virus. As a result, there were sharp decreased mortalities from transport injury and drowning at all age from different population across 20 cities from Guangdong, except for Chaozhou and male population aging from 70 to 79 years old.

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

fire, heat, and hot substances among elderly in Guangdong. A comprehensive fire, heat, and hot substances reduction strategy in the elderly is still lacking. Comprehensive strategy employing public education, distribution of firefighting equipment, adequate supervision for vulnerable adults while heating and cooking as well as the use of aging electric appliance to prevent fire, heat, and hot substances injury in the elderly warrants development and evaluation.

The death rate of falls declined overall for decades of years, yet with a notable increase in older people. This is probably due to the increased life expectancy in the past two decades. Greater proportion of older people living with chronic diseases were at risk of falls.[19] The problem is going to worsen among elderly during COVID-19 period, since elderly subjects remain exposed to trauma due to domestic falls with reduced number of health services.[20] In this case, older population were suffering from a higher risk of disability or death due to delayed care and treatment for fall-related injuries.[21-22] Given the relative high burden of falls among elderly, systematic implementation for reducing injuries from falls was needed including sufficient medical and occupational-therapy,[23] professional environment hazard assessment and modification,[24] vitamin D and calcium supplementation, hip protectors, reduction of many of the predisposing and situational risk factors.[25]

Self-harm is becoming a more pressing concern as the pandemic spreads and has longer-term effects on the general population, the economy, and vulnerable groups. There is some evidence that deaths by suicide increased in the USA during the 1918–19 influenza pandemic [26] and among older people in Hong Kong during the 2003 severe acute respiratory syndrome (SARS) epidemic.[27] The infectious disease epidemics seemed to serve as a catalyst to trigger the suicidal thought of people with mental health problems. As shown by our results, increased death rate for self-harm was observed at the age of 0-14 and 70-79 in both sex. The likely adverse effects of the pandemic on population mental health, might be exacerbated by fear, self-isolation and physical distancing,[28] contributing to an increase in the prevalence of PTSD symptoms, depression, anxiety and stress in general population in China during the COVID-19 outbreak.[29] Together with the extraordinary high

case fatality rate for those elderly patients,[30] older adults and people with mental health problems became even more worried. A higher risk of being exposed to family conflicts, physical and/or sexual violence at home and economic damage caused by the COVID-19 crisis may lead to increased suicide rates among children.[31] Loss of employment and financial stressors are also well-recognized risk factors for suicide. [32] Selective and universal interventions are required for targeted individuals at heightened risk of suicide, including making evidence-based online interventions freely available, increasing volunteer workforce for crisis hotlines, providing financial safety nets for unemployment support.[33] In addition, domestic violence and alcohol consumption might increase during lockdown. Public health responses must ensure that those facing interpersonal violence are supported and that safe drinking messages are communicated, particularly for bereaved individuals. Accessible health education and promotion for COVID-19 is recommended, regarding that the extent that people proactively engaged in hand hygiene could decrease the likelihood that the workforce experience psychiatric symptoms.[29,34]

One of the main limitations of measuring injury burden in Guangdong during COVID-19 period was a lack of reliable injury incidence data. Second, we need to be a bit more cautious about the causative effect of the COVID-19 epidemic on injury mortality, owning to the limitation of the observational study. Despite the limitations, this study are still considered to be robust. Death registration in Guangdong province is an all-cause of death surveillance which covering all the population living in Guangdong. Data from the registration system in recent years aligned well with the vital registration data that achieved large increases in coverage over the past decade.[35] Moreover, we have used the empirical method to avoid underestimation in death surveillance.

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

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

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

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

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

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

5. McIntyre RS, Lee Y. Projected increases in suicide in Canada as a consequence of COVID-19. Psychiatry Res. 2020;290:113104.

6. Li Z, Ge J, Yang M, et al. Vicarious traumatization in the general public, members, and non-members of medical teams aiding in COVID-19 control. Brain Behav Immun. 2020;88:916-919.

7. Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. Lancet Psychiatry. 2020;7(6):547-560.

8. Faul M, Xu L, Wald MM, Coronado VG. Traumatic brain injury in the United States: emergency department visits, hospitalizations and deaths 2002–2006. Atlanta: US Centers for Disease Control and Prevention; 2010.

9. Thurman DJ, Sniezek JE, Johnson D, Greenspan A, Smith SM. Guidelines for surveillance of central nervous system injury. Washington (DC): US Department of Health and Human Services; 1995.

10. Adair T, Lopez AD. Estimating the completeness of death registration: An empirical method. PLoS One. 2018; 13(5):e0197047.

11. Adams RS, Larson MJ, Corrigan JD, Ritter GA, Williams TV. Traumatic brain injury among U.S. active duty military personnel and negative drinking-related consequences. Subst Use Misuse. 2013; 48:821-36.

12. 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.

13. Leilei D, Pengpeng Y, Haagsma JA, et al. The burden of injury in China, 1990-2017: findings from the Global Burden of Disease Study 2017. Lancet Public Health. 2019;4(9):e449-e461.

14. Ministry of Education of the People's Republic of China. The education status of China in 2013. http://www.moe.gov.cn/jyb_sjzl/s5990/201503/t20150331_186797.html (accessed June 13, 2018;in Chinese).

15. The Central People's Government of the People's Republic of China. Circular of the State Council on printing and distributing the outline of the development of Chinese women and the program for the development of children in China. http://www.gov.cn/gongbao/content/2011/content_1927200.htm(accessed June 13, 2018; in Chinese).

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.

27. Cheung YT, Chau PH, Yip PS. A revisit on older adults suicides and severe acute respiratory syndrome (SARS) epidemic in Hong Kong. Int J Geriatr Psychiatry 2008; 23: 1231–38.

28. Yao H, Chen JH, Xu YF. Patients with mental health disorders in the COVID-19 epidemic. Lancet Psychiatry 2020; 7: e21

29. Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. Brain Behav Immun. 2020;87:40-48.

30. Guan WJ, Liang WH, Zhao Y, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. Eur Respir J. 2020;55(5):2000547.

31. Hoekstra PJ. Suicidality in children and adolescents: lessons to be learned from the COVID-19 crisis. Eur Child Adolesc Psychiatry. 2020;29(6):737-738.

32. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. Lancet 2009; 374: 315-23.

33. Gunnell D, Appleby L, Arensman E, et al. Suicide risk and prevention during the COVID-19 pandemic. Lancet Psychiatry. 2020;7(6):468-471.

34. Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19 pandemic stressful? A study on immediate mental health status and psychoneuroimmunity prevention measures of Chinese workforce. Brain Behav Immun. 2020;87:84-92.

35 . GBD 2017 Mortality Collaborators. Global, regional, and national age- and sex-specifc mortality and life expectancy for 195 countries and territories, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018;392: 1684–735.

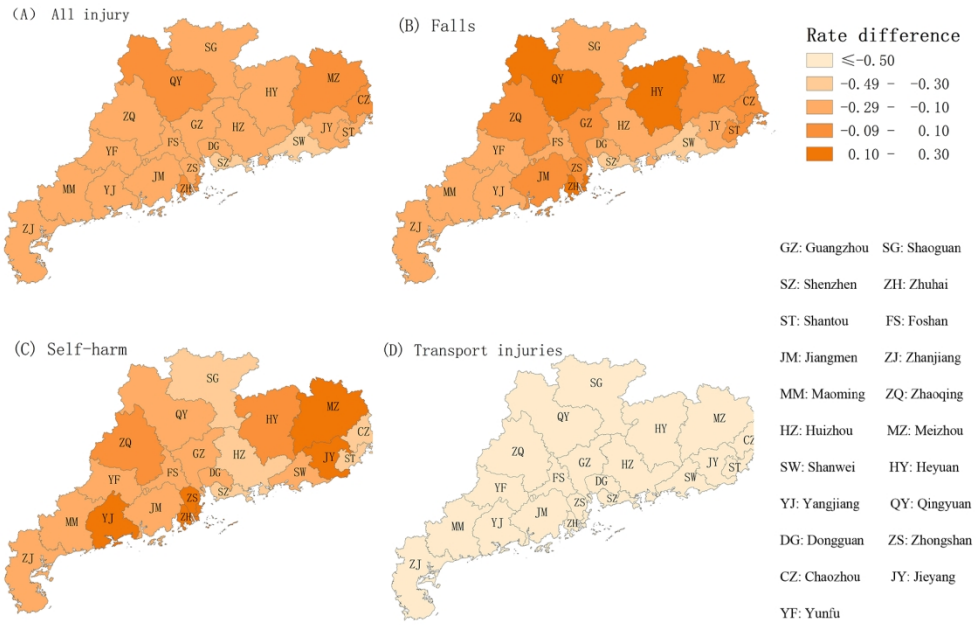

Figure 1. All injury, transport injuries, falls and self-harm mortality changes between the Covid-19 pandemic period and control period in 21 cities in Guangdong province, China.

160x119mm (300 x 300 DPI)

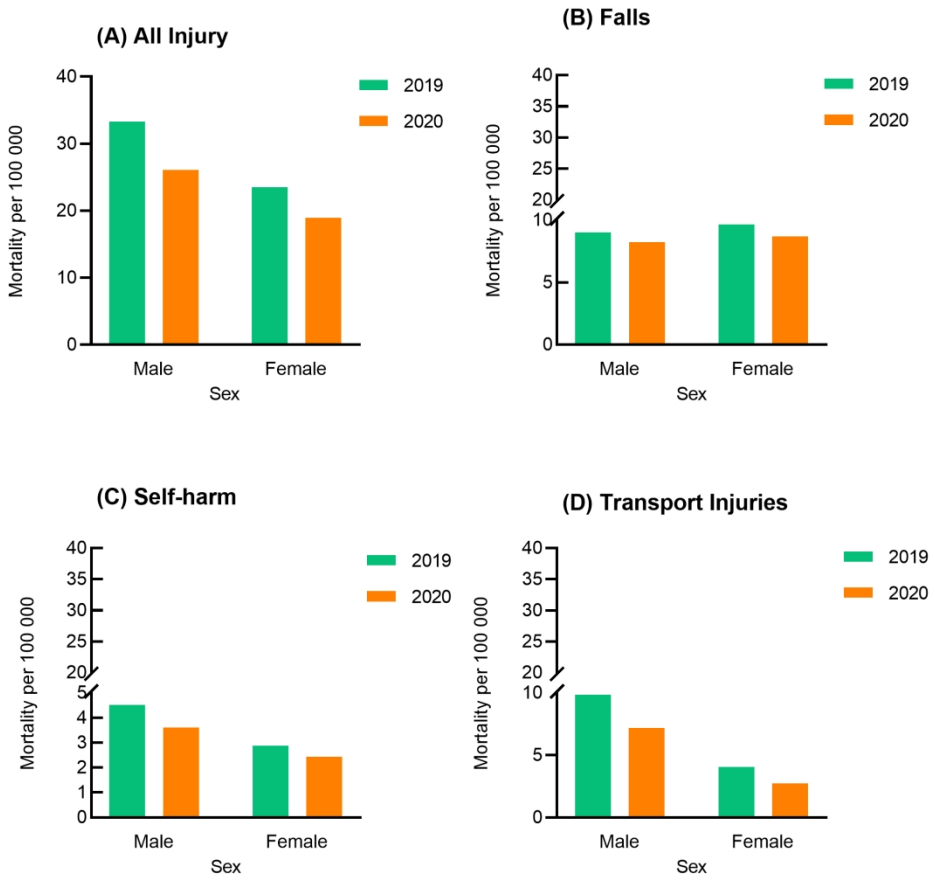

Figure 2. All injury, transport injuries, falls and self-harm in different sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

191x181mm (300 x 300 DPI)

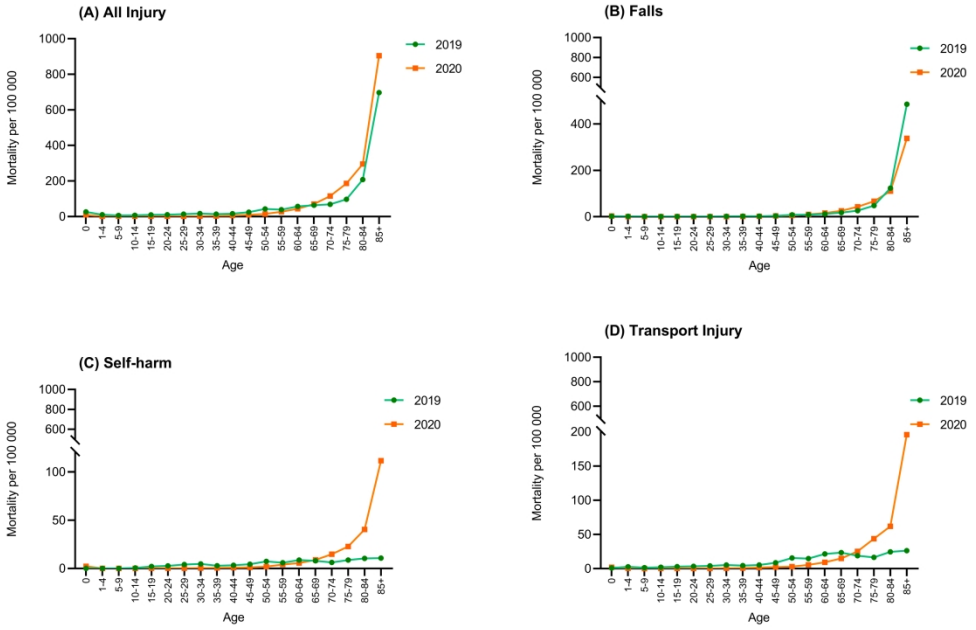

Figure 3. All injury, transport injuries, falls and self-harm mortality in different age groups between the Covid-19 pandemic period and control period in Guangdong province, China.

155x111mm (600 x 600 DPI)

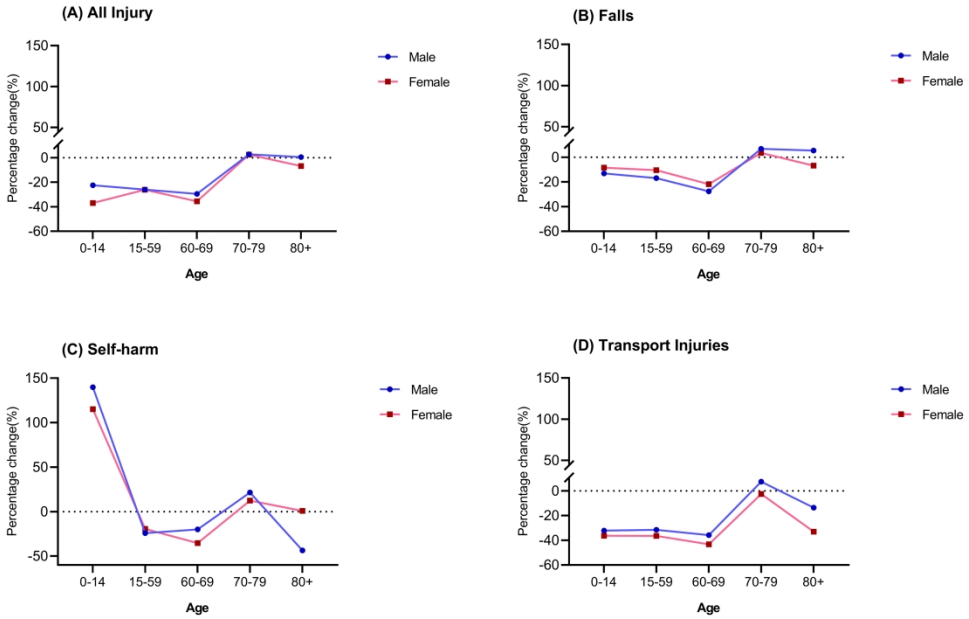

Figure 4. All injury, transport injuries, falls and self-harm mortality changes in different age and sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

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

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
Control Period in 2019									
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
Covid-19 Outbreak period									

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
Title and abstract	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
Introduction			
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
Methods			
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
Results			
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
Discussion			
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
Other information			
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.

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

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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 10th, 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

caused by the lockdown and quarantine measures during COVID-19 period. We sought to ascertain the injury mortality changes in Guangdong, China. This might help provide the evidence about the *status quo* of injury and metal health issues, as well as the guidance and actionable information for governments and public health authorities during the COVID-19 pandemic period.

Methods and material

Study design and data source

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

Definition of major injury category

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

Statistical analyses

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:

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

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

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

where C^{All} was the completeness of registration of all ages, $\log it\left(C^{All}\right)$ equated to $\ln\left(\frac{\text{C}^{\text{All}}}{1\text{-C}^{\text{All}}}\right)$, $RegCDR$ was the registered crude death rate (CDR), $RegCDR_{sq}$ was the square of *RegCDR*, %65 was the fraction of the population aged 65 years or greater, $\ln\left(5q0\right)$ was the natural log of the under-5 mortality rate, *Year* was calendar year, *γ* was a random effect, Predicted completeness was converted by using the inverse logit:

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

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 (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

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**)

Table2. 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	-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*

*: **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

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 prominent impact of COVID-19 on injury would not be fully captured. During the COVID-19 outbreak, most people avoided outdoor activities to minimize the use of healthcare services and the likelihood of SARS-CoV-2 infection (Severe Acute Respiratory Syndrome Coronavirus-2). Consequently, there has been a notable decrease in the mortality from transport injury and drowning at all age strata. Similar results have been documented in the UK [14] and India [15]. Degenerative spine and traumatic brain injuries also decreased significantly during the pandemic in UK [14]. The lockdown has grossly decreased the disability-adjusted life year caused by road traffic injury [15].

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

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

violence would sharply decrease because of the stringent lockdown and quarantine measures which could be fatal. The decrease in the mortality associated with social interpersonal violence might have largely been offset by the non-fatal incidence of household interpersonal violence.

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

Self-harm is becoming a more pressing concern as the pandemic is spreading rapidly and has the longer-term effects on the general population, the economy, and the vulnerable population. The infectious disease epidemics seemed to serve as a catalyst to trigger the suicidal thought of people with mental health problems [26-27]. Our results revealed an increased death rate for self-harm in the 0-14-year and 70-79-year group in both sexes. The likely adverse effects of the pandemic on children's mental health might be exacerbated by fear of being infected by SARS-CoV-2, self-isolation and physical distancing because of school closure [28]. These contributed to an increase in the prevalence of post-traumatic stress disorder symptoms, depression, anxiety and stress [29]. In conjunction with a higher risk of being exposed to the family conflicts, the household physical violence, academic stress and economic damage which were caused by the COVID-19 crisis might have collectively led to an increased 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

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

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

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

the COVID-19 period still warranted the targeted and universal interventions for the mass public.

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

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Competing interests:

We declare no competing interests.

Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information

Reference:

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

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

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

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

5. McIntyre RS, Lee Y. Projected increases in suicide in Canada as a consequence of COVID-19. Psychiatry Res. 2020;290:113104.

6. Li Z, Ge J, Yang M, et al. Vicarious traumatization in the general public, members, and non-members of medical teams aiding in COVID-19 control. Brain Behav Immun. 2020;88:916-919.

7. Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. Lancet Psychiatry. 2020;7(6):547-560.

8. Zhou M, Wang H, Zhu J, Chen W, Wang L, Liu S, et al. Cause-specific mortality for 240 causes in China during 1990-2013: a systematic subnational analysis for the Global Burden of Disease Study 2013. Lancet. 2016 Jan 16;387(10015):251-72.

9. Faul M, Xu L, Wald MM, Coronado VG. Traumatic brain injury in the United States: emergency department visits, hospitalizations and deaths 2002–2006. Atlanta: US Centers for Disease Control and Prevention; 2010.

10. Thurman DJ, Sniezek JE, Johnson D, Greenspan A, Smith SM. Guidelines for surveillance of central nervous system injury. Washington (DC): US Department of Health and Human Services; 1995.

11. Adair T, Lopez AD. Estimating the completeness of death registration: An empirical method. PLoS One. 2018; 13(5):e0197047.

12. Adams RS, Larson MJ, Corrigan JD, Ritter GA, Williams TV. Traumatic brain injury among U.S. active duty military personnel and negative drinking-related consequences. Subst Use Misuse. 2013; 48:821-36.

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

Referral Patterns During the Coronavirus Disease 2019 Pandemic: A United Kingdom Experience. World Neurosurg. 2020; 144:e414-e420.

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.

27. Cheung YT, Chau PH, Yip PS. A revisit on older adults suicides and severe acute respiratory syndrome (SARS) epidemic in Hong Kong. Int J Geriatr Psychiatry 2008; 23: 1231–38.

28. Yao H, Chen JH, Xu YF. Patients with mental health disorders in the COVID-19 epidemic. Lancet Psychiatry 2020; 7: e21

29. Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. Brain Behav Immun. 2020;87:40-48.

30. Hoekstra PJ. Suicidality in children and adolescents: lessons to be learned from the COVID-19 crisis. Eur Child Adolesc Psychiatry. 2020;29(6):737-738.

31. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. Lancet 2009; 374: 315-23.

32. Guan WJ, Liang WH, Zhao Y, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. Eur Respir J. 2020;55(5):2000547.

33. Gunnell D, Appleby L, Arensman E, et al. Suicide risk and prevention during the COVID-19 pandemic. Lancet Psychiatry. 2020;7(6):468-471.

34. Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19 pandemic stressful? A study on immediate mental health status and psychoneuroimmunity prevention measures of Chinese workforce. Brain Behav Immun. 2020;87:84-92.

35. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2095–128.

36 . GBD 2017 Mortality Collaborators. Global, regional, and national age- and sex-specifc mortality and life expectancy for 195 countries and territories, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018;392: 1684–735.

Figure legends:

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.

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

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.

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.

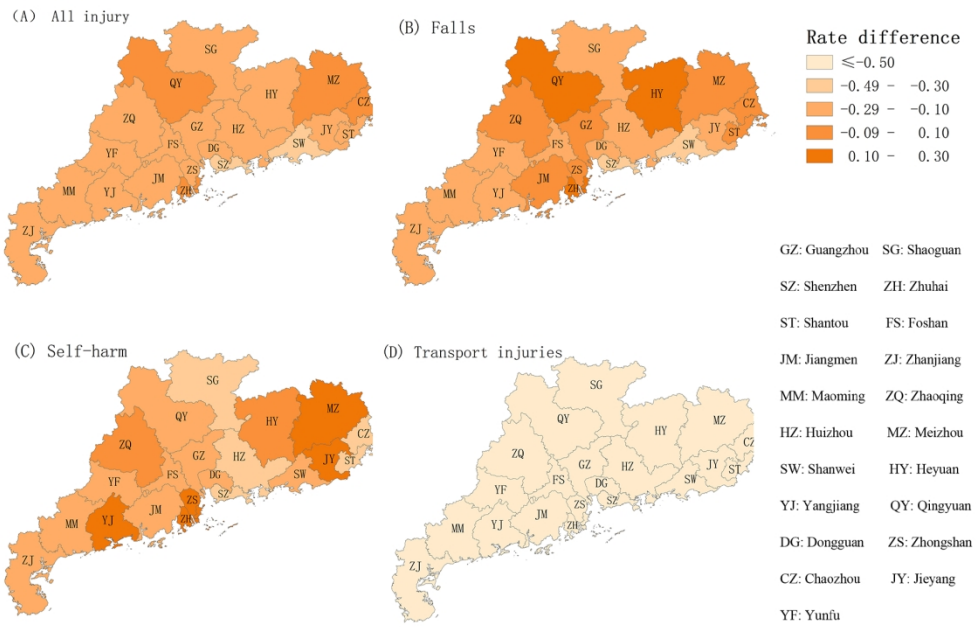

Figure 1. All injury, transport injuries, falls and self-harm mortality changes between the Covid-19 pandemic period and control period in 21 cities in Guangdong province, China.

160x119mm (300 x 300 DPI)

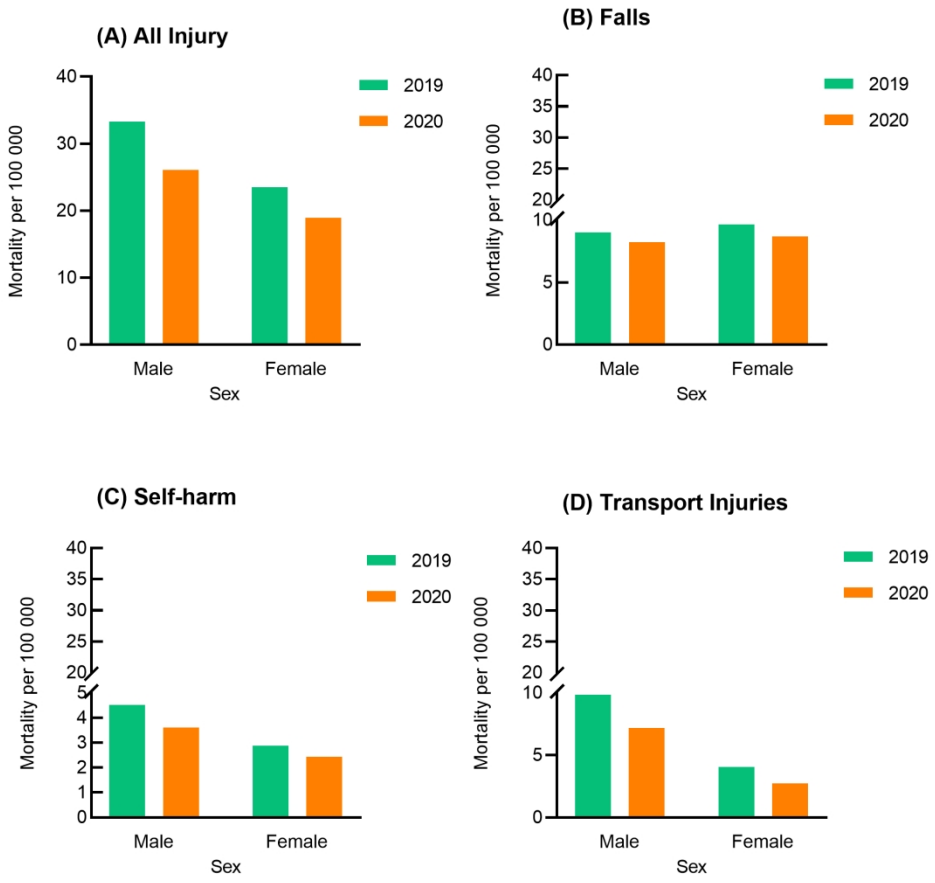

Figure 2. All injury, transport injuries, falls and self-harm in different sex groups between the Covid-19 pandemic period and control period in 21 cities in Guangdong province, China.

191x181mm (300 x 300 DPI)

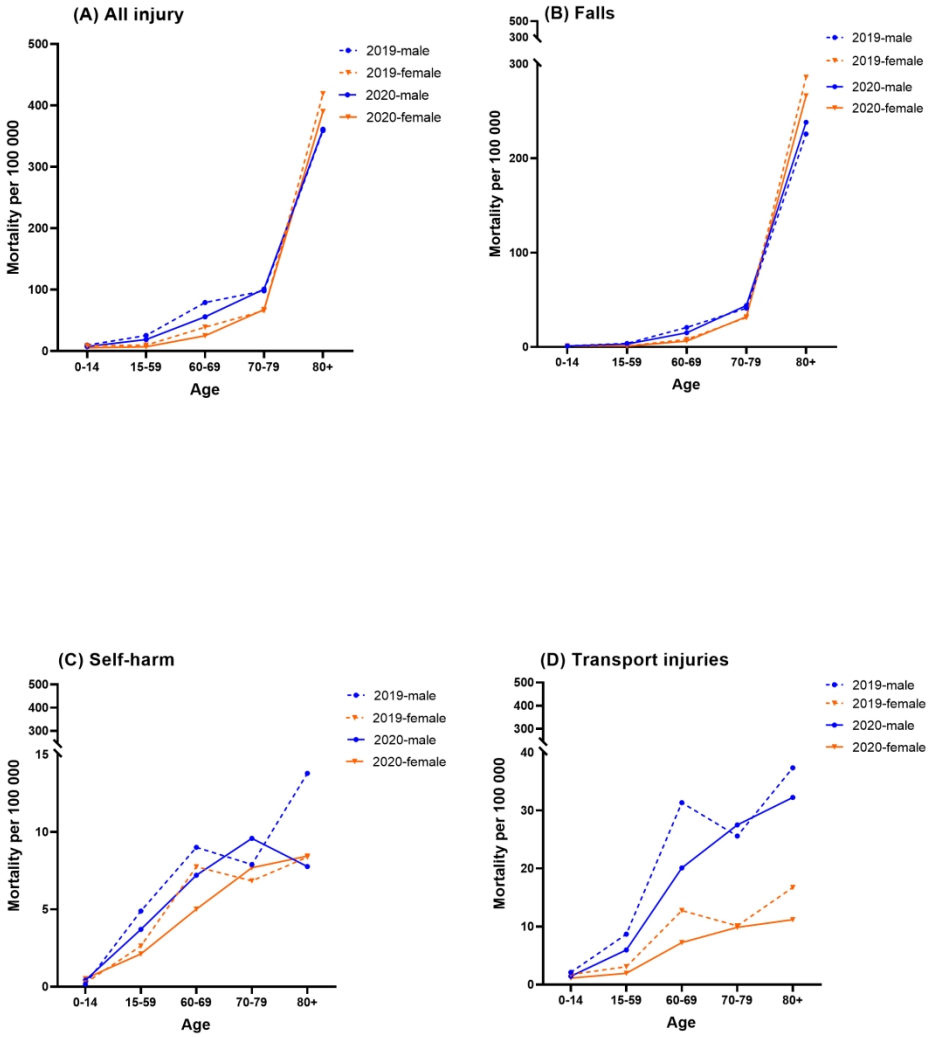

Figure 3. All injury, transport injuries, falls and self-harm mortality changes in different age and sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

198x216mm (300 x 300 DPI)

E-Table 1. Mortality 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

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)**

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
Control Period in 2019									
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
Covid-19 Outbreak period									

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

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 (No.)	Control period (No.)
All cause of injury	12858	15988
Transport injuries	2871	3978
Poisonings	591	667
Falls	4792	5209
Fire, heat, and hot 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
Control Period in 2019									
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
Covid-19 Outbreak period									

Male	0-14	77	13	55	4	118	22	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	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	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

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

Qingyuan	236	39	309	12	73	73	3	929
Dongguan	202	59	257	6	69	170	29	933
Zhongshan	156	33	130	9	30	65	4	487
Chaozhou	70	14	193	4	21	35	0	381
Jieyang	233	31	243	4	60	66	2	705
Yunfu	158	18	205	6	41	44	2	562
Guangdong	3970	659	5201	134	1045	2083	162	15998
Covid-19 Outbreak period								
Guangzhou	243	46	563	7	62	261	19	1633
Shaoguan	147	45	315	1	32	58	1	712
Shenzhen	45	17	69	0	7	274	7	485
Zhuhai	48	18	61	3	17	59	4	261
Shantou	84	17	201	3	24	44	2	444
Foshan	183	32	281	6	48	94	2	851
Jiangmen	216	17	350	6	49	77	5	845
Zhanjiang	240	30	211	18	52	51	1	726
Maoming	212	22	156	8	56	67	6	603
Zhaoqing	124	19	421	4	30	65	7	778
Huizhou	137	30	230	3	39	55	9	620

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
Title and abstract	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
Introduction			
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
Methods			
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
Results			
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
Discussion			
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
Other information			
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.

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

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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 10th, 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.

We hypothesized that there would be both physical and mental health issues caused by the lockdown and quarantine measures during the COVID-19 period. We sought to ascertain the injury mortality changes in Guangdong province. Our findings might help provide the evidence about the *status quo* of injury and metal health, as well as the guidance and actionable information for governments and public health authorities during the COVID-19 pandemic.

Methods and material

Study design and data source

We conducted a population-based retrospective analysis to compare the mortality changes of injury in different categories (including transport injuries, poisonings, falls, fire/heat/hot substances, drowning, self-harm and interpersonal violence, which were stratified by sex and age) between the study and control period. The study period was defined as the duration between the date of the identification of the first cases and the date when quarantine measures were implemented in Guangdong province (January 1st 2020) and the data cut-off (June 30th 2020). The control period was defined as a corresponding period during the previous year (from January 1st 2019 to June 30th 2019). Death registration is an all-cause of death surveillance which covers the whole population residing in Guangdong province. Mortality data were derived from the Chinese Center for Disease Control and Prevention (CDC) Cause of Death Reporting System [8].

Definition of major injury category

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

Statistical analyses

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, which served as the denominators for mortality calculation. The percentage changes were calculated with the following formula:

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

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:

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

where C^{All} was the completeness of the registration of all ages, $\log it\left(C^{All}\right)$ equaled to $\ln\left(\frac{\text{C}^{\text{All}}}{1\text{-C}^{\text{All}}}\right)$, $RegCDR$ was the registered crude death rate (CDR), $RegCDR_{sq}$ was the square of *RegCDR*, %65 was the fraction of the population aged 65 years or greater, $\ln\left(5q0\right)$ was the natural log of the under-5 mortality rate, *Year* was calendar year, *γ* was a random effect. The predicted completeness was converted by using the inverse logit: $\frac{e^{\text{logit}\left(C^{All}\right)}}{e^{\text{logit}\left(C^{All}\right)}+1}$

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* (10-14 years)	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*	127.00* (10-14 years)	-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	-	0.85	0.85	-6.86*

General population	Total	-32.78*	-16.62	-9.93*	-1.21	-42.37*	-40.67*	-15.17*	-46.06*	-17.58*
	0-14	-34.07*	-36.68*	-11.18	-52.00	-31.89*	139.26* (10-14 years)	-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*

*: 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

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

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

The causes of death from interpersonal violence have been multifactorial. Theoretically, unemployment and fear of acquiring COVID-19 would have predisposed to an increased incidence of household interpersonal violence that has been non-fatal. By contrast, both the incidence and mortality of social interpersonal violence would sharply decrease because of the stringent lockdown and quarantine measures which might have been fatal. The decrease in the mortality associated with social interpersonal violence might have largely been offset by the non-fatal incidence of household interpersonal violence.

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

Self-harm is becoming a more pressing concern as the pandemic is spreading rapidly and has the longer-term effects on the general population, the economy, and the vulnerable population. The infectious disease epidemics seemed to serve as a catalyst to trigger the suicidal attempt of people with mental health disorders [26-27]. Our results revealed an increased death rate for self-harm in the 10-14-year and 70-79-year group in both sexes. The likely adverse effects of the pandemic on children's mental health might be exacerbated by fear of being infected by SARS-CoV-2, self-isolation and physical distancing because of school closure [28]. These contributed to an increase in the prevalence of post-traumatic stress disorder symptoms, depression, anxiety and stress [29]. In conjunction with a higher risk of being exposed to the family conflicts, the household physical violence, academic stress and economic damage which were caused by the COVID-19 crisis might have collectively led to an increased 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 family conflict [31], might have aggravated during the lockdown. Despite of the mental health disorders and the family conflict, the elderly might be increasingly concerned because of the extraordinarily high case-fatality rate [32]. This might have also

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

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

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

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

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

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Competing interests:

We declare no competing interests.

Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information

Reference:

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

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

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

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

5. McIntyre RS, Lee Y. Projected increases in suicide in Canada as a consequence of COVID-19. Psychiatry Res. 2020;290:113104.

6. Li Z, Ge J, Yang M, et al. Vicarious traumatization in the general public, members, and non-members of medical teams aiding in COVID-19 control. Brain Behav Immun. 2020;88:916-919.

7. Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. Lancet Psychiatry. 2020;7(6):547-560.

8. Zhou M, Wang H, Zhu J, Chen W, Wang L, Liu S, et al. Cause-specific mortality for 240 causes in China during 1990-2013: a systematic subnational analysis for the Global Burden of Disease Study 2013. Lancet. 2016 Jan 16;387(10015):251-72.

9. Faul M, Xu L, Wald MM, Coronado VG. Traumatic brain injury in the United States: emergency department visits, hospitalizations and deaths 2002–2006. Atlanta: US Centers for Disease Control and Prevention; 2010.

10. Thurman DJ, Sniezek JE, Johnson D, Greenspan A, Smith SM. Guidelines for surveillance of central nervous system injury. Washington (DC): US Department of Health and Human Services; 1995.

11. Adair T, Lopez AD. Estimating the completeness of death registration: An empirical method. PLoS One. 2018; 13(5):e0197047.

12. Adams RS, Larson MJ, Corrigan JD, Ritter GA, Williams TV. Traumatic brain injury among U.S. active duty military personnel and negative drinking-related consequences. Subst Use Misuse. 2013; 48:821-36.

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 Referral Patterns During the Coronavirus Disease 2019 Pandemic: A United Kingdom Experience. World Neurosurg. 2020; 144:e414-e420.

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.

27. Cheung YT, Chau PH, Yip PS. A revisit on older adults suicides and severe acute respiratory syndrome (SARS) epidemic in Hong Kong. Int J Geriatr Psychiatry 2008; 23: 1231–38.

28. Yao H, Chen JH, Xu YF. Patients with mental health disorders in the COVID-19 epidemic. Lancet Psychiatry 2020; 7: e21

29. Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. Brain Behav Immun. 2020;87:40-48.

30. Hoekstra PJ. Suicidality in children and adolescents: lessons to be learned from the COVID-19 crisis. Eur Child Adolesc Psychiatry. 2020;29(6):737-738.

31. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. Lancet 2009; 374: 315-23.

32. Guan WJ, Liang WH, Zhao Y, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. Eur Respir J. 2020;55(5):2000547.

33. Gunnell D, Appleby L, Arensman E, et al. Suicide risk and prevention during the COVID-19 pandemic. Lancet Psychiatry. 2020;7(6):468-471.

34. Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19 pandemic stressful? A study on immediate mental health status and psychoneuroimmunity prevention measures of Chinese workforce. Brain Behav Immun. 2020;87:84-92.

35. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2095–128.

36 . GBD 2017 Mortality Collaborators. Global, regional, and national age- and sex-specifc mortality and life expectancy for 195 countries and territories, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018;392: 1684–735.

Figure legends:

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.

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

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.

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.

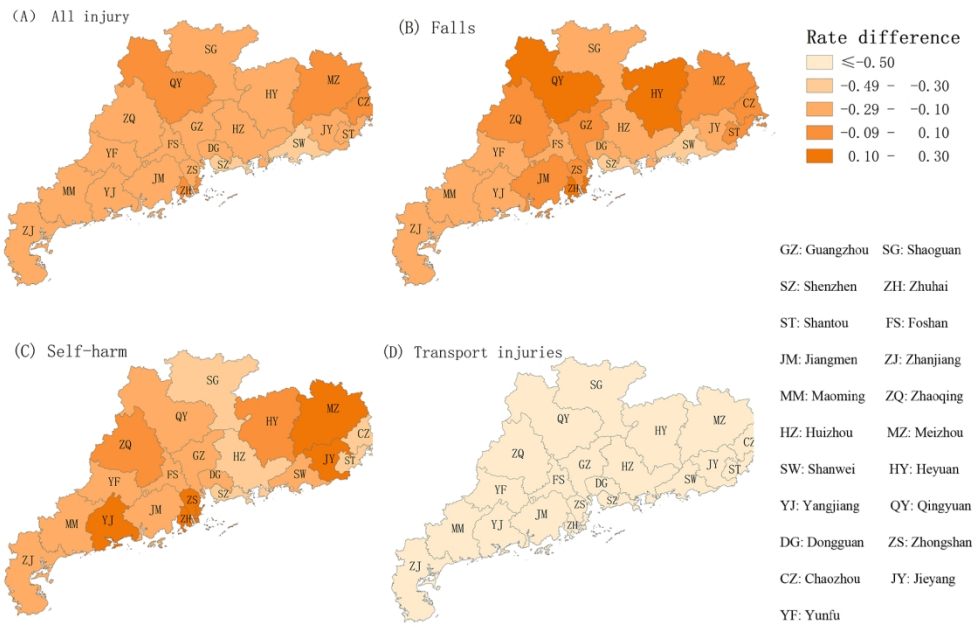

Figure 1. All injury, transport injuries, falls and self-harm mortality changes between the Covid-19 pandemic period and control period in 21 cities in Guangdong province, China.

160x119mm (300 x 300 DPI)

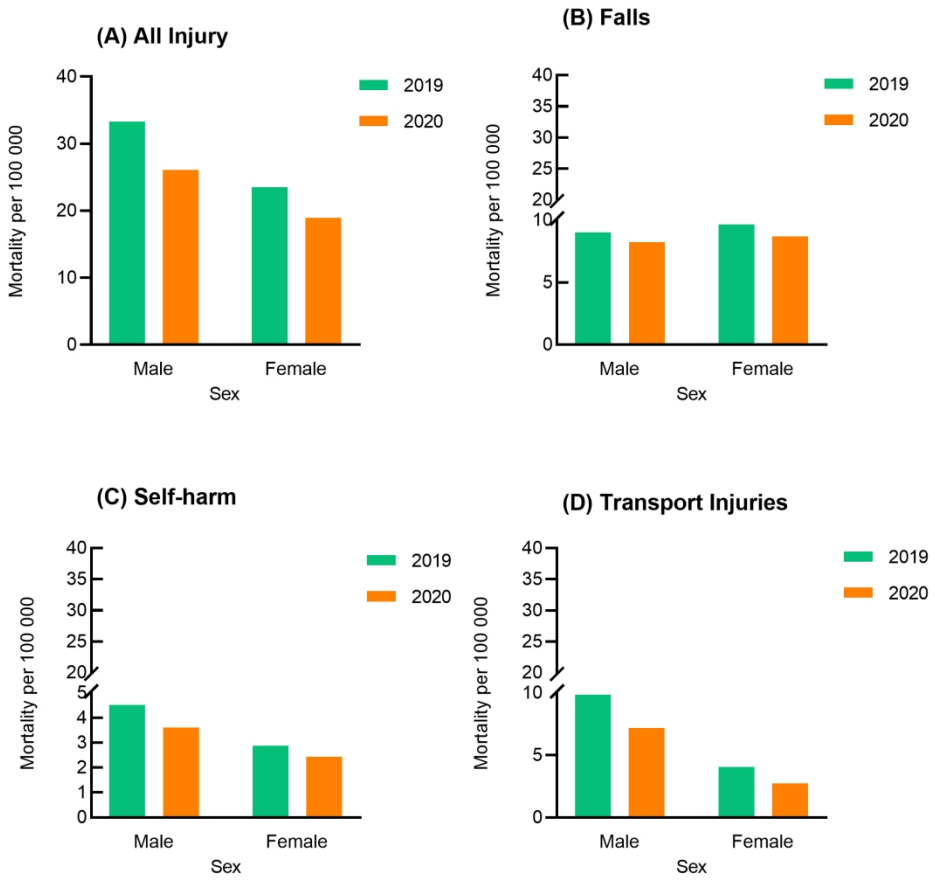

Figure 2. All injury, transport injuries, falls and self-harm in different sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

191x181mm (300 x 300 DPI)

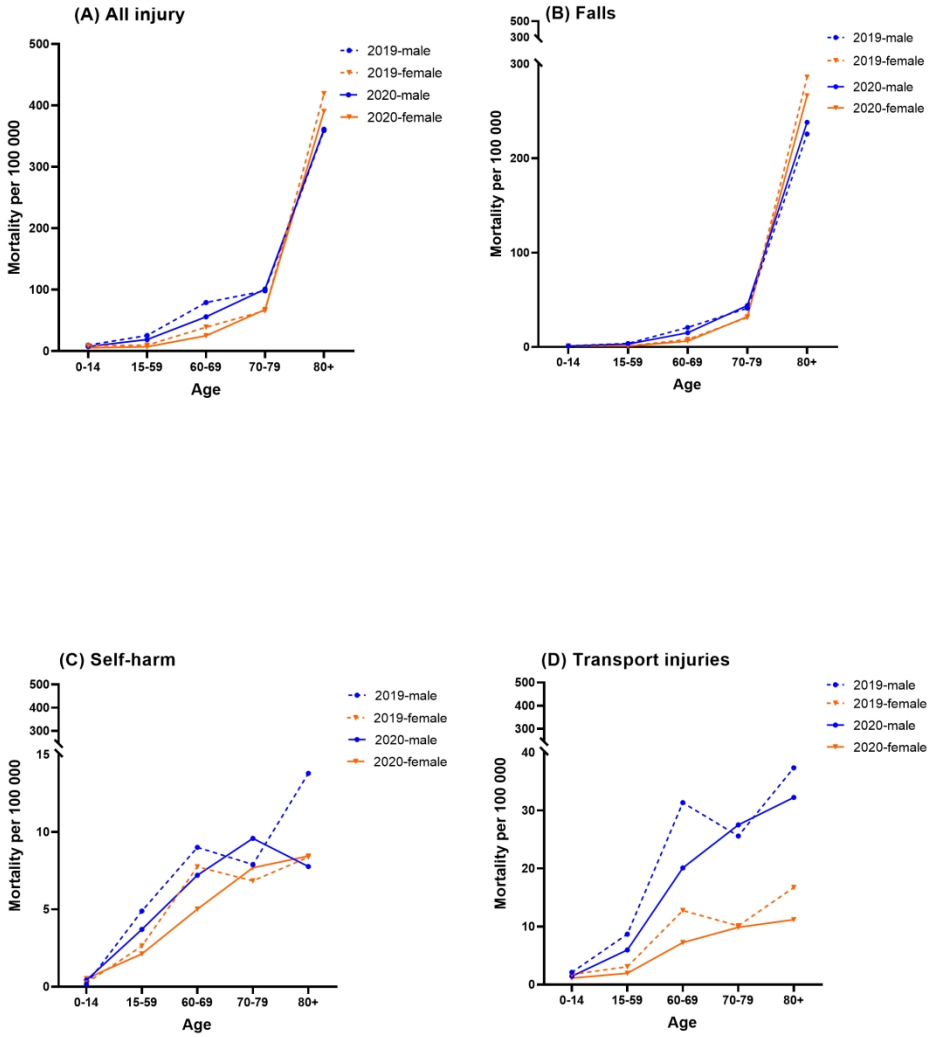

Figure 3. All injury, transport injuries, falls and self-harm mortality changes in different age and sex groups between the Covid-19 pandemic period and control period in Guangdong province, China.

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
Control Period in 2019									
Male	0-14	2.12	0.41	1.18	0.25	2.72	0.53 (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 (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 (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
Covid-19 Outbreak period									
Male	0-14	1.44	0.25	1.02	0.08	2.2	1.32 (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 (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 (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 (No.)	Control period (No.)
All cause of injury	12858	15988
Transport injuries	2871	3978
Poisonings	591	667
Falls	4792	5209
Fire, heat, and hot 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
Control Period in 2019									
Male	0-14	113	22	63	13	145	9 (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 (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 (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
Covid-19 Outbreak period									
Male	0-14	77	13	55	4	118	22 (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 (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 (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
Title and abstract	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
Introduction			
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
Methods			
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
Results			
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
Discussion			
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
Other information			
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.