The uncounted casualties of a hidden COVID-19 epidemic in China: a cross-sectional study on overwork deaths based on crowdsourced data

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Abstract

Background: During COVID-19 response, non-clinical essential workers usually work overtime and face strong work stress, which will subsequently increase risk of dying from cardiovascular diseases, stroke, and pre-existing conditions. Deaths on duty, including overwork death(s), during the COVID-19 response, were usually reported online for public recognition and solidarity. Though no official statistics is collecting those causalities, an online list of on-duty deaths has been made publicly available by crowdsourcing.

Objective: This study aims to understand the trends and characteristics of the overwork death(s) among the frontline non-clinical essential workers participating in non-pharmaceutical interventions during the first wave of COVID-19 in China.

Methods: Based on an online crowdsourced list of deaths on duty during the first wave of COVID-19 response in China, we manually verified the overwork death records with the full text of the online reports from credible sources. After excluding deaths caused by COVID-19 infections and accidents, 340 overwork death(s) among non-clinical essential were attributed to combatting COVID-19. We coded the key characteristics of deceased workers including sex, age at death, location, causes of death, date of incidence et cetera. The temporal and spatial correlations between overwork death(s) and COVID-19 cases in China were also examined using Pearson correlation coefficient.

Results: From January 20 to April 26, at least 340 non-clinical frontline workers in China were documented to have died from overwork when combatting COVID-19. The weekly overwork mortality was positively correlated with weekly COVID-19 infections (r=0.72, p= .005). Two-thirds of deceased workers were under 55 years old. Two major causes of overwork death(s) were cardiovascular diseases (40.6%), and cerebrovascular diseases (21.2%). Outside of Hubei there were almost 2.5 times as many deaths caused by COVID-19 related overwork (n=308) than by the disease itself (n=120).

Conclusions: The high number of overwork death(s) among non-clinical essential workers on the front lines of the COVID-19 epidemic is alarming. Policies of occupational health protection against work hazards should be prioritized and enforced. Clinical Trial: NA

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Short Paper

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Abstract

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Results: From January 20 to April 26, at least 340 non-clinical frontline workers in China were documented to have died from overwork when combatting COVID-19. The weekly overwork mortality was positively correlated with weekly COVID-19 infections (r=0.79, *p*=< .001). Two-thirds of deceased workers were under 55 years old. Two major causes of overwork deaths were

cardiovascular diseases (40.6%), and cerebrovascular diseases (21.5%). Outside of Hubei there were almost 2.5 times as many deaths caused by COVID-19 related overwork (n=308) than by the disease itself (n=120).

Conclusions: The high number of overwork deaths among non-clinical essential workers on the front lines of the COVID-19 epidemic is alarming. Policies of occupational health protection against work hazards should be prioritized and enforced.

Keywords: Non-pharmaceutical interventions; on-duty deaths; COVID-19; overwork death; crowdsourced data.

Introduction

The first wave of COVID-19 epidemic in China was brought under control in three months from mid-January (the confirmation of human-to-human transmission of COVID-19) to the end of April .[1] The effective containment of the initial wave of COVID-19 in China was credited to not only the frontline medical response, but also swift, massive, and aggressive non-pharmaceutical interventions (NPIs).[2] Implementation of such interventions was time-sensitive and labour-intensive, demanding the continuous efforts of staff from all sectors to meet community healthcare and logistical needs, such as setting up checkpoints for temperature screening, conducting travel history inquiries to screen for suspected cases, and protecting incarcerated people in prisons and detention houses. However, while the COVID-19 infections and deaths among medical professionals have been well acknowledged,[3] the health of non-clinical essential workers engaged in NPIs to contain coronavirus should not be overlooked.

In China, these frontline workers have suffered from high levels of psychological and physical stress, and worked long hours without sufficient rest for weeks, even months, due to rapid acceleration of the epidemic and understaffing.[4] It has long been recognized that “overwork” can kill,[5] as the

prolonged working hours and heightened psychological stress increase the risk of coronary heart disease and stroke via the pathway of increased secretion of catecholamine, eventually leading to increased mortality risk[6-8] However, the hidden casualties of these “overwork deaths” have not been studied. Deaths on duty during the COVID-19 response were usually reported by online news platform for public recognition and solidarity, but no official statistics is collecting those causalities. Fortunately, an online list of on-duty in the combat against COVID-19 has been made publicly available by crowdsourcing and recognised by the Chinese public.[9] This study aims to conduct a comprehensive search of online news reports to describe the trends and characteristics of overwork deaths in the fight against the COVID-19 epidemic in China.

Methods

Based on a widely recognized list of on-duty deaths in fight against COVID-19 in China, from January 20 to April 26, 2020, 496 deaths on duty were included, with no duplication.[9] All records of deaths in the line with duty have been verified with the full text of the online reports from credible news platforms such as Xinhua News Agency, People’s Daily, Sohu.com, Sina.com et cetera., and government official websites (Detailed sources could be found in Appendix 1). When the on-duty death reports explicitly mentioned overwork and the deaths were not attributed to COVID-19 infections or accidents, then these deaths would be identified as overwork deaths. After excluding deaths caused by COVID-19 infections and accidents, 340 (69.11%) overwork deaths among non-clinical essential workers were attributed to combatting COVID-19.

We coded the key characteristics of 340 deceased workers including sex, age at death, location, causes of death, date of incidence, date of death, containment duties, working area, and occupation (eTable in the Appendix 1). The date of incidence refers to the date when the frontline worker’s health condition deteriorated suddenly due to overwork and he/she could no longer perform his/her duties, while the date of death refers to the date when the overwork death occurred. If a frontline

worker died from overwork immediately or was found dead, date of incidence and date of death would be the same. However, if the frontline worker's health condition deteriorated suddenly due to overwork, but only died after several days of rescue and treatment at the hospital then the date of incidence and date of death would be different. This study only used the date of incidence to analyze the trends and correlation of overwork deaths and COVID-19 incidence, as it reflected the timely physical and psychological stress caused by the severity of the epidemic.

In addition, the number of daily overwork deaths and daily COVID-19 incidences were aggregated into weekly COVID-19 incidence to reflect the time trends of overwork deaths and COVID-19 incidence.[9] The temporal correlation between weekly overwork morality and COVID-19 incidence, and the spatial correlation between provincial overwork deaths and COVID-19 case counts were also examined using Pearson correlation. The correlation coefficients (r) are statistically significant, once p value is less than 0.05. When examining the correlation, as a sensitivity analysis, we have also only analyses cases who died within the two day of the date of incidence. This study was approved by the institutional review board of Research Center for Public Health, School of Medicine, Tsinghua University.

Results

The first overwork deaths occurred on 24 January, and during the 14 weeks from January 20 to April 26, at least 340 non-clinical frontline workers in China were documented to have died from overwork in the fight against the COVID-19 epidemic. Both the number of COVID-19 infections (n=30,396) and the number of overwork deaths (n=53) reached its apex in the fourth week after January 20. Weekly overwork mortality was positively correlated with weekly COVID-19 infections (r=0.79, p<0.001). 86.5% of cases died within two days of the incidence. As the sensitivity analysis,

if only considering those cases, the temporal correlation between weekly overwork mortality and weekly COVID-19 infections would increase to 0.81 (p<0.001)

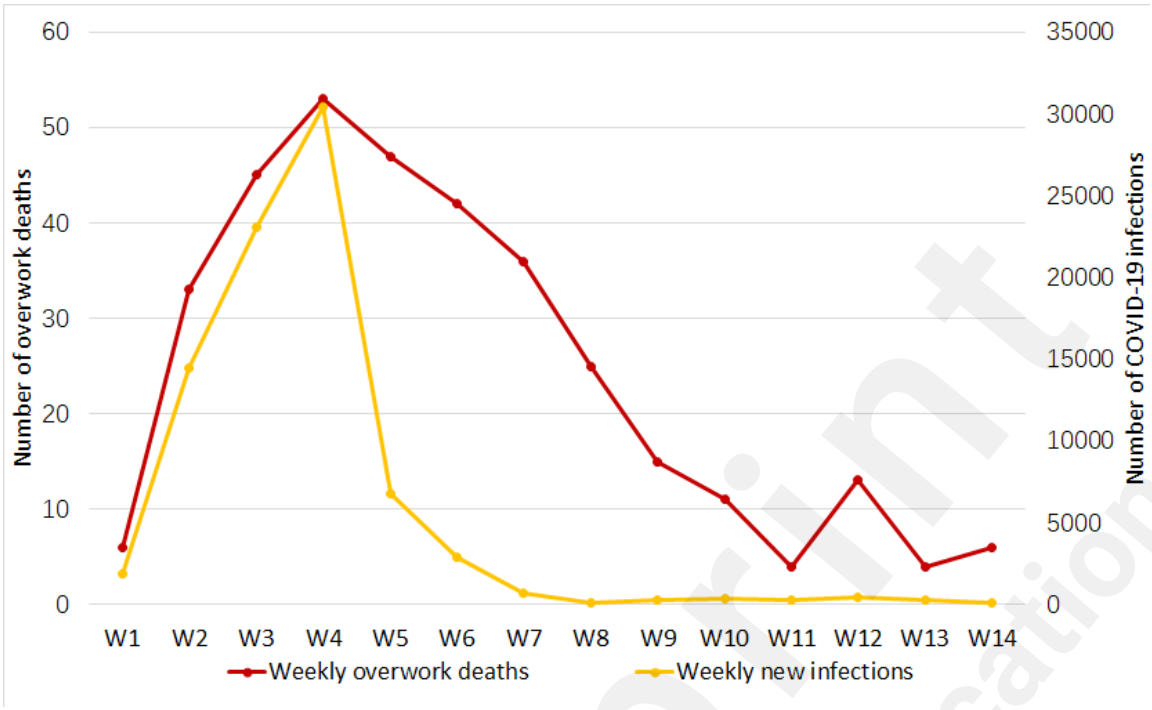

Figure 1. Trends of weekly overwork deaths and COVID-19 incidence between January 20 and April 26, 2020 in China.

Among those who were overworked to death (Table 1), the mean age at death was 49.50 years (SD=9.13), with two-thirds under 55 years old. Two major specified underlying causes of death were cardiovascular diseases (40.6%) such as myocardial infarction and sudden cardiac arrest, and cerebrovascular diseases (21.5%) such as stroke. A majority of the overwork deaths were among males (95.3%) in China, which reflected that the epidemic containment responsibilities were carried out by village leaders (32.6%), policemen (28.2%), and civil servants (17.1%), which are traditionally male-dominated occupations in China. Most deceased workers were involved in community mobilization and support (63.8%), including community closure and access control, temperature check, travel history collection, daily necessities delivery et cetera, followed by public

security (22.6%). Apart from working in rural (45.9%) and urban (38.8%) settings, 15.3% deceased workers were used to work at traffic checkpoints at expressway and prisons and detention houses.

Table 1. Characteristics of documented frontline workers died from overwork during the emergency response to COVID-19 in China between January 20 and April 26, 2020 (N=340)

	N (%)
Sex	
Female	16 (4.7)
Male	324 (95.3)
Age	
25–34	21 (6.2)
35–44	69 (20.3)
45–54	140 (41.2)
55–64	92 (27.1)
65–71	15 (4.4)
Unspecified	3 (0.9)
Working area	
Rural	156 (45.9)
Urban	132 (38.8)
Other [a]	52 (15.3)
Underlying cause of death	
Cardiovascular diseases	138 (40.6)
Cerebrovascular diseases	73 (21.5)
Other specific causes	27 (7.9)
Unspecified [b]	102 (30.0)
Epidemic containment duty	
Community mobilisation and support	217 (63.8)
Public security	77 (22.6)
Traffic checkpoint and control	30 (8.5)
Other [c]	17 (5.0)
Occupation	
Village leaders	111 (32.6)
Policeman	96 (28.2)
Civil servant	58 (17.1)

Volunteer	32 (9.4)
Other public sectors [d]	26 (7.1)
Corporate employee	17 (5.0)
Location	
Hubei Province	32 (9.4)
Outside Hubei Province	308 (90.6)
Difference between date of incidence and data of death	
0 day	244(71.8)
1 day	36(10.6)
2 days	14(4.1)
>2days	46(13.5)

[a] Other working areas include prisons, detention houses, and traffic checkpoints at the expressway.
[b] Other causes of death include acute hepatic failure, acute pancreatitis, pre-existing conditions etc.
[c] Other epidemic containment duties include logistics, electricity/telecommunication maintenance, health communication etc.
[d] Other public sectors include schools, and institutions funded by the government.

In addition, there were 32 overwork deaths in Hubei province, which reported the highest prevalence of COVID-19 in China, and 308 deaths outside Hubei province. Among non-Hubei provinces, the provincial overwork deaths were positively correlated with the number of COVID-19 infections (r=0.55, p= .002); if only considering cases died within 2 days of incidence, the correlation coefficient remains nearly the same (r=0.55, p= .002).

Discussion

This study utilised the manually verified crowdsourced online data to illustrate the trends and characteristics of overwork deaths, which were casualties of the effort to contain the COVID-19 epidemic in China. The 340 overwork deaths reveal a hidden “epidemic within the epidemic” that has not been documented and further sounded the alarm of fatigue and occupational burnout among non-clinical frontline workers. The severity of the epidemic presented a great health burden to those who were involved in the battle against COVID-19, and it explains why the peak of overwork deaths was synchronized with the peak of the COVID-19 pandemic. Notably, outside Hubei province, there were over 2.5 times as many deaths caused by COVID-19 related overwork (n=308) than by the

disease itself (n=120),[10] and the provincial overwork deaths were correlated with the COVID-19 case counts, signaling the high intensity of non-pharmaceutical interventions to curb the COVID-19 epidemic.

This epidemic embodies the health threats that all non-clinical essential workers faced. Firstly, non-clinical essential workers had mental distress due to the fear of contracting COVID-19. Unlike ordinary residents under home quarantines, non-clinical essential workers had to work outside to perform their duties, especially screening for suspected COVID-19 cases. During the early stages of the epidemic in China, all personal protective equipment (PPE) for clinical staff was prioritized,[11] and thus the non-clinical workers faced a shortage of PPE, which may have heightened their fears of COVID-19 infection. Secondly, most of the containment strategies were implemented by public sector employees, and they were accountable by law and regulation for containing the epidemic. They faced huge work stress and workload due to understaffing, especially among those non-Hubei provinces. Chinese central government dispatched many clinical and non-clinical workers from other provinces to support Hubei province,[10] while for other provinces, they had to manage to contain the transmission of COVID-19 largely on their own. Non-clinical essential workers worked overtime at the peak of the epidemic, which may increase the risk of dying from cardiovascular and cerebrovascular diseasesdisease[6,7]. Thirdly, due to understaffing, many workers with preexisting conditions joined the workforce in the intensive battle against COVID-19. Those workers did not have enough time to rest and recover, and their pre-existing poor health conditions may have deteriorated and contributed to the observed overwork deaths.

Our study also has some limitations. Firstly, the overwork deaths were identified based on online news reports, not from the hospital health records, thus there may exist misclassification. We have verified the full-text of overwork deaths' reports using credible and official sources to minimise the misclassification. In addition, the length and details of individual reports varied and, as such, some

characteristics could not be retrieved and coded. Lastly, the number of overwork deaths were likely to be underestimated as not every incident was reported online.

The high number of overwork deaths among essential workers on the front lines of the COVID-19 epidemic is alarming. While protection for health workers in the line of duty against COVID-19 has been a global focus,[11,13] policies of occupational health protection against work hazards such as adequate training, sufficient PPE, and proper working shifts, should be prioritized and enforced.[11] Counseling services should be provided to mitigate the psychosocial impacts. The possibility of a second wave of COVID-19 cannot be ruled out,[14] so NPIs will likely remain in place until there is a breakthrough in treatment or a vaccination becomes widely available.

Conclusions

This cross-sectional study based on online crowdsourced data emphases that overwork deaths among non-clinical essential workers should be acknowledged. Corresponding policies of occupational health protection against overwork death should be implemented. These non-clinical essential workers are the unsung heroes, and their safety and well-being should be prioritized as they constitute society's front line of defense against the virus.

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Conflicts of Interest

None declared

Abbreviations

NPIs: non-pharmaceutical interventions; PPE: personal protective equipment

Ethics approval and consent to participate This study was approved by the Institutional Review Board of Research Center for Public Health, School of Medicine, Tsinghua University. THUSM/PHREC 2020400-009.

Consent for publication Not applicable

Availability of data and materials: All data generated or analysed during this study are included in this published article and its supplementary information files.

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Authors' contributions: ZW and KT conceptualise this study. ZW acquired, cleaned and verified the data, conducted the statistical analysis, and wrote the first manuscript. All other authors (LL, YG, and HX) participated in the interpretation of results and critically revised it. All authors approve the final version to be submitted.

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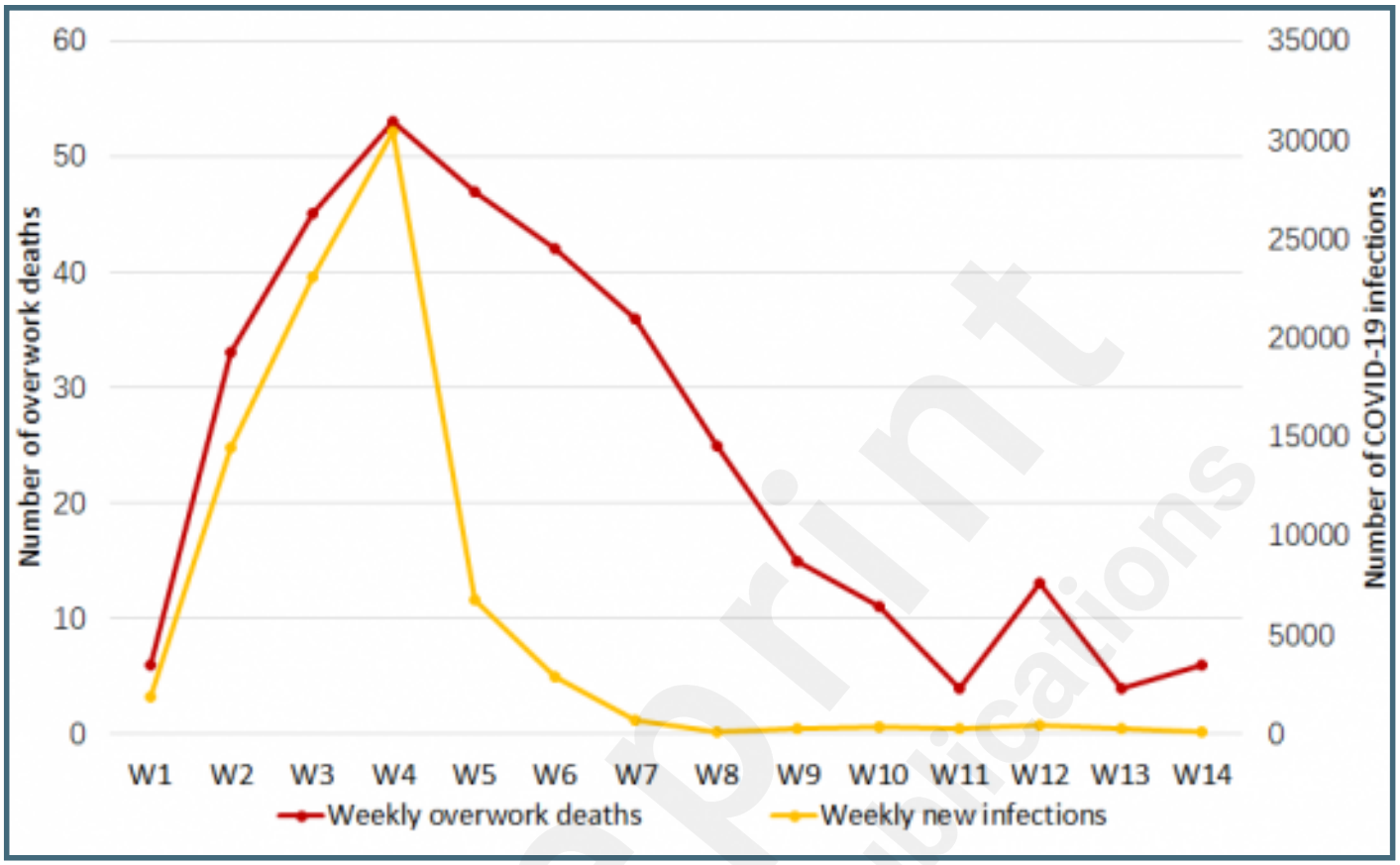
Supplementary Files

Figures

Trends of weekly overwork deaths and COVID-19 incidence between January 20 and April 26, 2020 in China.



Multimedia Appendixes

Supplementary eTable. Deidentified individual characteristics of documented frontline workers died from overwork during the emergency response to COVID-19 between January 20 and April 26, 2020 in China.
URL: http://asset.jmir.pub/assets/0dec2e7f020466dd96b3889eddd1f84a.xlsx