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Preplanned Studies

Perspectives

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Cover Photo: Apothecia of *Gyromitra venenata*, a new poisonous species discovered from China, 2020 (photo authorized for use).

Preplanned Studies

Mushroom Poisoning Outbreaks — China, 2020

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Summary

What is already known about this topic?

Acute liver failure, rhabdomyolysis, acute renal failure, and hemolysis caused by poisonous mushrooms are the most important mushroom poisoning threats to the Chinese population. The most notorious lethal mushrooms are the species from genera *Amanita*, *Lepiota*, and *Galerina* that cause acute liver failure, and *Russula subnigricans* that leads to rhabdomyolysis.

What is added by this report?

In 2020, the total number of investigations reached 676, involving an estimated 102 species of poisonous mushrooms, 24 of which were newly recorded in China. *Gyromitra venenata* was newly discovered in incidents in Yunnan and Guizhou provinces and were the first reported poisonings due to gyromitrins in China since 2000. The rare poisoning Shiitake mushroom dermatitis was recorded in China. Hemolysis poisoning caused by *Paxillus involutus* was recorded for the second time since the beginning of the new century, resulting in one death in Inner Mongolia Autonomous Region.

What are the implications for public health practice?

Promoting knowledge about safe consumption of mushrooms is essential to reduce mushroom poisonings. It is not wise to collect and eat wild mushrooms. For southwestern provinces such as Yunnan, especially, caution must be exercised with unfamiliar mushroom species.

Preventing mushroom poisonings depends on cooperation between clinical doctors, CDC experts, and mycologists as well as the application of internet technology tools (*1*). Systematic epidemiological investigations, timely and accurate species identification, toxin detection, and appropriate diagnosis and treatment are key to properly controlling mushroom poisoning events.

In 2020, a total of 676 independent mushroom poisoning incidents from 24 provincial-level administrative divisions (PLADs) involving 1,719 patients and 25 deaths were investigated and the overall mortality was 1.45%. The number of cases ranged from 1 to 27,[*] and 14 outbreaks involved more than 10 patients. Of these cases, 93 patients from 24 incidents had eaten poisonous mushrooms purchased from market or given by friends; 51 patients from 12 incidents had been poisoned after eating dried mushrooms; 404 patients from 131 incidents with 7 deaths ate mixed mushrooms. Three rare clinical syndromes were recorded: Gamma-Aminobutyric Acid (GABA)-blocking mushroom poisoning caused by *Gyromitra venenata*, Hemolysis poisoning caused by *Paxillus involutus*, and Shiitake mushroom dermatitis caused by *Lentinula edodes*. Similar to 2019, mushroom poisonings occurred in every month but were centered from June to October (*1*). There were 2 peaks appearing in June and September involving 160 and 193 incidents, 428 and 412 patients, and 8 and 3 deaths, respectively (Figure 1).

In terms of geographical distribution, Southwest China [Yunnan, Guizhou, Sichuan, Chongqing, and Xizang (Tibet)] were the most severely affected region with 200 incidents, 604 patients, and 15 deaths. Central China (Hunan, Hubei, and Jiangxi) had more incidents (323 incidents), more patients (707 patients), but less deaths (4 deaths). East China (Anhui, Fujian, Jiangsu, and Zhejiang) had 82 incidents, 159 patients, and 0 deaths and were followed by the other regions: South China (Guangdong, Guangxi, and Hainan) had 33 incidents, 146 patients, and 3 deaths; North China (Beijing, Hebei, Henan, Shandong, and Shanxi) had 22 incidents, 69 patients, and 1 death; Northwest China (Ningxia and Gansu) had 13 incidents, 30 patients, and 1 death; and Northeast China (Inner Mongolia and Liaoning) had 3 incidents, 4 patients, and 1 death. In addition, 3 Burmese workers in Yunnan had gastroenteritis after eating *Chlorophyllum*

[*] The median number of cases per incident was two.

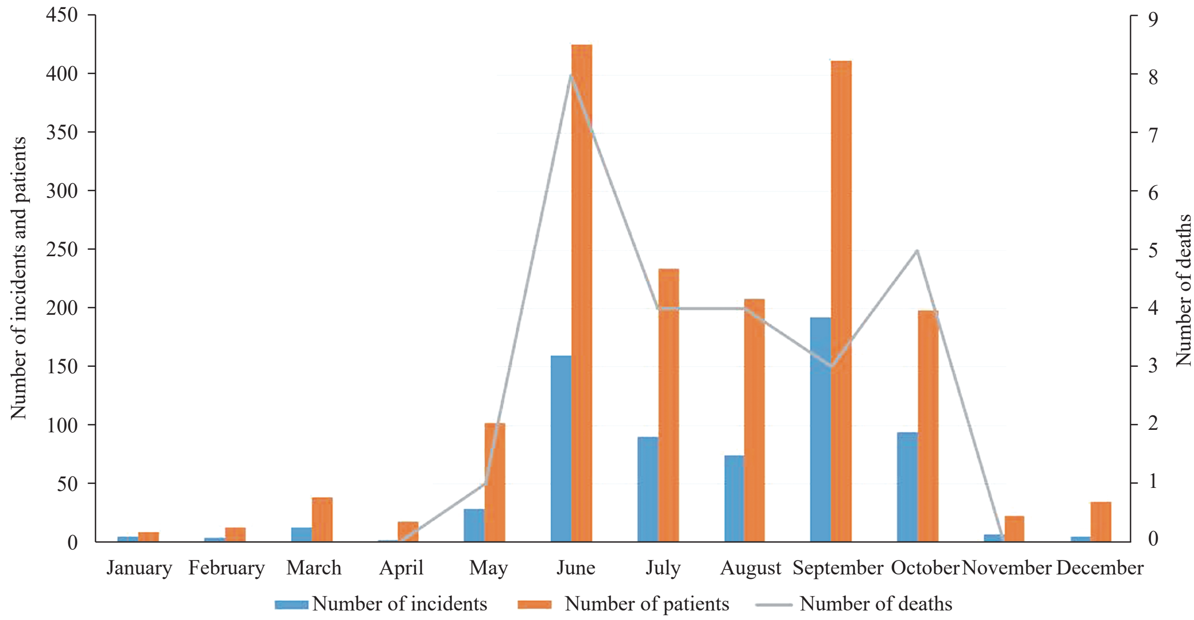

FIGURE 1. Monthly distribution of mushroom poisonings in China, 2020.

molybdites. Detailed information for each PLAD was displayed in Table 1.

Approximately 102 species of poisonous mushroom causing seven different clinical syndromes (acute liver failure, acute renal failure, rhabdomyolysis, hemolysis, gastroenteritis, psycho-neurological disorder, and Shiitake mushroom dermatitis) (*2–3*) were successfully identified. In 2020, 24 species were newly recorded as poisonous mushrooms and were added to the Chinese poisonous mushroom list. The most lethal 3 mushroom species were *Lepiota brunneoincarnata*, *Russula subnigricans*, and *Amanita subpallidorosea* killing 5, 4, and 4 people, respectively (Supplementary Table S1, available in http://weekly.chinacdc.cn/). *Chlorophyllum molybdites* caused the most poisonings (appearing in 154 incidents, 304 patients), were the most widely distributed mushroom (discovered in 15 PLADs) and had the longest active period (from late March to late October) in China, 2020 (Supplementary Table S1).

Similar to 2019, the same 9 species causing acute liver failure were identified in China, 2020 (*1*). *Lepiota brunneoincarnata* was found to be the most dangerous species in 2020, being responsible for 15 incidents, 29 patients, and 5 deaths as the lone cause or in combination with other species. *Lepiota brunneoincarnata* was discovered under coniferous trees, but in 2 incidents occurring in 2020, it was found in hardwood forest dominated by fagaceous trees in Guizhou and under *Ziziphus jujube* in Mengcun County, Hebei Province. The incident in Hebei Province on August 29 involved 6 patients. *Amanita exitialis* also appeared in Guangdong in late February, which was earlier than in 2019 but resulted in less deaths (*1*). There were also more incidents of patients consuming a combination of poisonous mushrooms, which can cause greater difficulties and risks for diagnosis and treatment due to species resulting in different symptoms (Supplementary Table S1).

Amanita gymnopus was a species discovered from poisoning investigations causing acute renal failure that was not found in 2019 (*1*). Due to delayed diagnosis and treatment, 3 people were killed by *A. pseudoporphyria* in early June in Guangxi. *Amanita oberwinklerana* was discovered in 18 incidents from 8 PLADs. *Amanita oberwinklerana*, a species occurring in southern China, also caused 6 incidents including 11 patients in North China for the first time from late July to late September. More deaths were caused by *Russula subnigricans*, which leads to rhabdomyolysis, when compared to 2019 (*1*, Supplementary Table S1).

On September 12–13, 2 incidents involving 2 patients and 1 death caused by *Paxillus involutus* resulting hemolysis occurred in Chifeng and Tongliao, Inner Mongolia Autonomous Region. Clinically, this type of poisoning stimulates an autoimmune reaction, with a short incubation period (usually 30 min–3 h), followed by gastrointestinal tract effects (GIT) including nausea, vomiting, abdominal pain, and/or diarrhea. Intravascular haemolysis, anaemia, with potential secondary renal failure, shock, disseminated

TABLE 1. Geographical distribution of mushroom poisoning incidents, cases, deaths, and case fatality in China, 2020.

PLADs	Number of incidents	Number of patients	Deaths	Case fatality (%)
Hunan	302	666	3	0.45
Yunnan	81	244	7	2.87
Guizhou	43	148	7	4.73
Zhejiang	43	78	0	0
Sichuan	40	123	1	0.81
Chongqing	35	88	0	0
Fujian	18	42	0	0
Guangxi	15	87	3	3.45
Anhui	12	30	0	0
Ningxia	12	29	1	3.45
Hubei	12	24	1	4.16
Guangdong	11	21	0	0
Jiangxi	9	17	0	0
Jiangsu	9	9	0	0
Beijing	8	23	0	0
Hainan	7	38	0	0
Hebei	7	33	0	0
Shandong	3	8	1	12.50
Henan	3	3	0	0
Inner Mongolia	2	2	1	50.00
Liaoning	1	2	0	0
Shanxi	1	2	0	0
Gansu	1	1	0	0
Xizang (Tibet)	1	1	0	0
Total	676	1,719	25	1.45

Abbreviation: PLADs=provincial-level administrative divisions.

intravascular coagulopathy, and acute respiratory failure developed on the following few days and even caused death (*3*).

A total of 56 species causing gastroenteritis were identified from mushroom poisoning incidents in China in 2020 (Supplementary Table S1). Among them, *Baorangia major*, *Chlorophyllum demangei*, *Entoloma caespitosum*, *Gymnopus densilamellatus*, *Lactarius atromarginatus*, *Lactifluus deceptivus*, *Lf. puberulus*, *Leucocoprinus cretaceous*, *Micropsalliota furfuracea*, *Neonothopanus nambi*, *Pholiota multicingulata*, *Pulveroboletus subrufus*, *Russula rufobasalis*, and *Tricholoma stans* were species newly discovered as poisonous mushrooms and subsequently added to the Chinese poisonous mushroom list (*1–2*, *4–6*). This was the first report of *Baorangia major* in China. The top 3 species were *Chlorophyllum molybdites*, *Russula japonica*, and *Entoloma omiense*, which was the same as 2019, but these 3 species caused more incidents and had wider geographical distribution (*1*).

About 28 species causing psycho-neurological disorders were identified from mushroom poisoning incidents in China in 2020, including *Clitocybe subditopoda*, *Gyromitra venenata*, *Inocybe* aff. *ericetorum*, *Mallocybe fulvipes*, *Inosperma* aff. *virosum*, *Inosperma* cf. *virosum*, *Pseudosperma* cf. *bulbosissimum*, and *Pseudosperma yunnanense*, which were species newly discovered as poisonous mushrooms and thus added to Chinese poisonous mushroom list (*1–2*, *7–9*). The top five species are *Amanita subglobose*, *A. rufoferruginea*, *Gymnopilus dilepis*, *A. melleiceps*, and *A. sychnopyramis* f. *subannulata* (Supplementary Table S1). Among them, *Gyromitra venenata* is a new species discovered from Yunnan and Guizhou resulting 4 patients poisoned as containing gyromitrins (*7*).

Inosperma aff. *virosum* and *Inosperma* cf. *virosum* were potentially two new independent species resulting in typical muscarinic syndrome post ingestion.

Lentinula edodes, commonly known as Shiitake mushroom, is one of the most famous edible mushrooms worldwide (*2*). Shiitake mushroom dermatitis was also reported, though its pathophysiology is unclear at present (*3*,*10*). Clinically, this type of mushroom poisoning presents 1–2 days post ingestion of raw or cooked mushrooms with sudden onset of whiplike (flagellate) linear wheals on limbs, trunk, and/or face/neck, and its toxin was assumed to be the thermolabile polysaccharide, lentinan (*3*,*10*). On January 5, an individual showed typical Shiitake mushroom dermatitis after eating *L. edodes* from Jiangxi. However, two other people who also consumed *L. edodes* were asymptomatic.

About 33 edible species were also identified from mushroom poisoning incidents in 2020 (Supplementary Table S1). These poisoning incidents may be attributed to consumption of mixed mushrooms with poisonous mushrooms, contaminated mushrooms, or some species potentially poisonous to certain people.

DISCUSSION

When comparing incidents in 2019 to 2020, more mushroom poisoning incidents occurred (276 in 2019 *vs.* 676 in 2020) involving more patients (769 *vs.* 1719) and deaths (22 *vs.* 25) (*1*). As in 2019, monthly distribution analysis showed that mushroom poisonings occurred every month and were centered from June to October; however, 1 peak appeared in July in 2019 (*1*), while 2 peaks (June and September) appeared in 2020. Geographical distribution analysis showed that mushroom poisoning incidents were reported in 24 PLADs in 2020—among which, 16 PLADs also reported cases in 2019 with the new PLADs being Anhui, Jiangxi, Beijing, Hebei, Inner Mongolia, Liaoning, Gansu, and Xizang (Tibet) (Supplementary Table S1). The PLADs with the highest number of mushroom poisonings were Hunan, Yunnan, Guizhou, Zhejiang, and Sichuan in 2020 (Supplementary Table S1), and Hunan, Yunnan, Zhejiang, Guizhou, and Chongqing in 2019 (*1*). Yunnan and Guizhou had the most deaths (*7*) in 2020, but in 2019, Yunnan had 14 deaths (*1*). Approximately 102 species of poisonous mushrooms were identified in incidents in 2020, among which 35 species were also identified in 2019, and the total number reached approximately 130 species.

In Spring 2020, 4 people were poisoned by “false morels” resulting in typical metabolic-based pathology secondary to blocking of GABA synthesis in multiple organs. Clinically, the incubation period is 5–12 hours or longer, followed by gastrointestinal system effects, ataxia, hypoglycaemia, haemolysis, methaemoglobinaemia, or even hepatic damage (*3*). Another study showed that this species was different from *Gyromitra esculenta* and represented a new species described as *G. venenata* (*7*).

Paxillus involutus was used as medicine for treating lumbago, skelalgia, and limb numbness in China and was considered edible in some areas of Northeast China, and recent studies also showed it was a good source of antioxidant (*2*). However, *Paxillus involutus* was reported as causing hemolysis after repeated exposure, and its toxins and poisoning mechanism are still unclear (*3*). The 2 incidents in 2020 involving 6 people but only 2 persons were poisoned with 1 death and the other developing renal failure. For safety, we strongly advise not to collect and eat this species although it seems safe to many people.

Gerhardtia sinensis was identified in 2 incidents involving 6 patients and treated as a highly suspected poisonous species in 2019 (*1*). In 2020, this species caused 4 incidents involving 13 patients and was confirmed as poisonous although its toxicology was still unclear (Supplementary Table S1). Another mushroom causing 5 people GIT on August 23 from Dehong, Yunnan, was identified as *Lactifluus pseudoluteopus*. As no toxicological knowledge is available, this mushroom is highly suspected as poisonous presently although several closely related species are edible (*4*).

Patients from many mushroom poisoning incidents consumed mixed wild mushrooms (Supplementary Table S1), and these poisonous mushrooms often caused different clinical syndromes, which put them at high risk. For example, patients consuming together *Amanita fuliginea* and *A. neoovoidea*, *A. fuliginea* and *A. pseudoporphyria*, or *A. fuliginea* and *A. oberwinklerana* could cause acute liver failure and acute renal failure at the same time (Supplementary Table S1). *Coprinus comatus* is a widely consumed mushroom, but as it is matures, coprine accumulates and may lead GIT, especially when combined with alcohol. Therefore, we strongly advise not combining consumption of mixed wild mushrooms and alcohol.

Over 1,000 edible mushrooms and approximately 500 poisonous species were reported in China (*1*–*2*,*4*).

Morphologically, many poisonous species are similar to edible ones, e.g. the lethal *Russula subnigricans* causing rhabdomyolysis is similar to the edible *R. nigricans*, making it hard to differentiate and repeatedly causing poisoning incidents. Educated individuals with the ability to recognize poisonous mushrooms and people aware of the risk of eating wild mushrooms are the basis for mushroom poisoning prevention and control. Therefore, science education is of great importance for reducing mushroom poisoning. In the last few years, many educational science materials for mushroom poisonings in China were produced with cooperation from governments, CDCs, doctors, and mycologists.

Accurate and timely species identification is of pivotal importance in mushroom poisoning incidents, and progress has been made as more incidents were properly identified, which could better guide the diagnosis and treatments for patients. The number of incidents with satisfactory mushroom identification grew from only 2 during 2010–2014 (*11*) to over 200 in 2019 (*1*) and over 600 in 2020. The growing number of poisonous mushroom identifications suggests that what we know only a portion of the variety of poisonous mushrooms. Many species need to be formally described and their edibility is not clear. More effort and closer cooperation are still needed urgently from local and national governments, CDC staff, doctors, and mycologists to properly control mushroom poisoning events.

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REFERENCES

1. Li HJ, Zhang HS, Zhang YZ, Zhang KP, Zhou J, Yin Y, et al. Mushroom poisoning outbreaks — China, 2019. China CDC Weekly 2020;2(2):19 – 24. http://dx.doi.org/10.46234/ccdcw2020.005.
2. Wu F, Zhou LW, Yang ZL, Bau T, Li TH, Dai YC. Resource diversity of Chinese macrofungi: edible, medicinal and poisonous species. Fungal Divers 2019;98:1 – 76. http://dx.doi.org/10.1007/s13225-019-00432-7.
3. White J, Weinstein SA, De Haro L, Bédry R, Schaper A, Rumack BH, et al. Mushroom poisoning: a proposed new clinical classification. Toxicon 2019;157:53 – 65. http://dx.doi.org/10.1016/j.toxicon.2018.11.007.
4. Wang XH. Taxonomic comments on edible species of Russulaceae. Mycosystema 2020;39(9):1617 – 39. http://dx.doi.org/10.13346/j.mycosystema.200209. (In Chinese).
5. Ge ZW, Jacobs A, Vellinga EC, Sysouphanthong P, Van Der Walt R, Lavorato C, et al. A multi-gene phylogeny of *Chlorophyllum* (Agaricaceae, Basidiomycota): new species, new combination and infrageneric classification. MycoKeys 2018;32:65 – 90. http://dx.doi.org/10.3897/mycokeys.32.23831.
6. Kanokmedhakul S, Lekphrom R, Kanokmedhakul K, Hahnvajanawong C, Bua-Art S, Saksirirat W, et al. Cytotoxic sesquiterpenes from luminescent mushroom *Neonothopanus nambi*. Tetrahedron 2012;68(39):8261 – 6. http://dx.doi.org/10.1016/j.tet.2012.07.057.
7. Li HJ, Chen ZH, Cai Q, Zhou MH, Chen GJ, Sun CY, et al. *Gyromitra venenata*, a new poisonous species discovered from China. Mycosystema 2020;39(9):1706 – 18. http://dx.doi.org/10.13346/j.mycosystema.200146.
8. Fan YG, Bau T. Taxonomy in *Inocybe* subgen. *Mallocybe* from China. J Fungal Res 2016;14(3):129 – 32, 141. http://dx.doi.org/10.13341/j.jfr.2014.1124.
9. Fan YG, Bau T. Taxonomy and phylogeny of *Inocybe* subgen. *Inosperma* from China. J Fungal Res 2018;16(1):17 – 27. http://dx.doi.org/10.13341/j.jfr.2018.1204.
10. Nguyen AH, Gonzaga MI, Lim VM, Adler MJ, Mitkov MV, Cappel MA. Clinical features of shiitake dermatitis: a systematic review. Int J Dermatol 2017;56(6):610 – 6. http://dx.doi.org/10.1111/ijd.13433.
11. Zhou J, Yuan Y, Lang N, Yin Y, Sun CY. Analysis of hazard in mushroom poisoning incidents in China mainland. Chin J Emerg Med 2016;25(6):724 – 8. http://dx.doi.org/10.3760/cma.j.issn.1671-0282.2016.06.008. (In Chinese).

SUPPLEMENTARY TABLE S1. Mushroom species involved in poisoning incidents and their spatial and temporal distribution in China, 2020.

Mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Acute liver failure					
Amanita exitialis	11	36	2	5.56	Feb 24 to Mar 30, Guangdong; June 22 to July 22, Yunnan
Amanita fuliginea	9	23	0	0	June 1 to July 18, Hunan and Guizhou
Amanita fuliginea and *A. neoovoidea*[ARF]	1	2	0	0	June 28, Zhejiang
Amanita fuliginea and *A. pseudoporphyria*[ARF]	2	3	0	0	June 2 to 9, Hunan
Amanita fuliginea and *A. subjunquillea*[ALF]	1	4	3	75.00	July 18, Guizhou
Amanita fuliginea and *A. oberwinklerana*[ARF]	1	2	0	0	June 23, Hunan
Amanita fuliginea and *A. fritillaria*[G/P]	3	9	0	0	June 5 to 15, Hunan
Amanita* cf. *fuliginea	2	9	0	0	June 18 to June 19, Guizhou and Chongqing
Amanita pallidorosea	4	7	0	0	June 16 to July 8, Guizhou
Amanita pallidiorosea and *A. sinocitrina*[P]	1	1	0	0	June 30, Guizhou
Amanita pallidorosea and *A. fritillaria*[G/P]	1	2	0	0	June 30, Chongqing
Amanita rimosa	4	10	0	0	June 6 to 27, Hunan, Hubei, and Chongqing
Amanita rimosa and *Lepiota brunneoincarnata*[ALF]	1	4	0	0	June 12, Hunan
Amanita subjunquillea	6	28	0	0	June 18 to 28, Guizhou; Aug 20 to Sept 2, Hebei and Beijing
Amanita subpallidorosea	4	8	4	50.00	Sept 16 to Oct 15, Yunnan and Guizhou
Amanita subpallidiorosea, A. citrina[P] and ***Lactifluus puberulus***[G]	1	3	0	0	Oct 20, Guizhou
Amanita sp., *Psathyrella candolleana*[G/P], *Russula* sp.[U] and *Agaricus* sp.[U]	1	2	1	50.00	July 13, Sichuan
Galerina sulciceps	6	12	2	16.67	Oct 8 to 16, Yunnan, Sichuan, and Guizhou
Lepiota brunneoincarnata	14	28	5	17.86	May 13 to July 3, Hubei, Hunan, and Jiangsu; Aug 19 to 30, Ningxia, Gansu, Shandong, Hebei and Liaoning
Lepiota brunneoincarnata and *Gymnopus dryophilus*[G]	1	1	0	0	Sept 14, Guizhou
Rhabdomyolysis					
Russula subnigricans	10	26	4	15.38	June 26 to Oct 4, Yunnan, Zhejiang, and Hunan
Russula subnigricans and *R. japonica*[G]	1	4	0	0	July 5, Yunnan
Russula subnigricans and *Entoloma prismaticum*[U]	1	2	0	0	Aug 8, Sichuan
Acute renal failure					
Amanita gymnopus	3	4	0	0	June 14 to July 7, Hunan and Yunnan; Oct 10, Zhejiang
Amanita neoovoidea	4	4	0	0	Sept 24 to Oct 19, Hunan and Sichuan
Amanita oberwinklerana	14	36	0	0	June 6 to July 5, Guizhou, Chongqing, Hunan, and Jiangsu; July 26 to Sept 25, Henan, Shanxi, Beijing, Hebei and Hunan
Amanita oberwinklerana and *A.* cf. *ibotengutake*[P]	1	1	0	0	Sept 5, Beijing
Amanita oberwinklerana and *A. pseudoporphyria*[ARF]	2	3	0	0	June 3 to Sept 30, Hunan
Amanita pseudoporphyria	14	49	3	6.12	June 6 to Oct 14, Hunan, Guangxi, and Yunnan
Amanita aff. *pseudoporphyria*	3	10	0	0	June 6 to Oct 5, Hunan

Continued

Mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Amanita pseudoporphyria and *Suillus placidus*[G] (dried mushrooms)	1	3	0	0	Dec 16, Hunan
Hemolysis					
Paxillus involutus	2	2	1	50.00	Sept 12 to 13, Inner Mongolia
Gastroenteritis					
Baorangia major	1	4	0	0	May 25, Fujian
Baorangia major and *B. pseudocalopus*[G]	1	7	0	0	July 19, Yunnan
Baorangia sp.	1	5	0	0	July 23, Yunnan
Boletellus cf. *emodensis*	1	1	0	0	Aug 12, Yunnan
Chlorophyllum demangei and *Scleroderma aurantiacum*[G]	1	2	0	0	July 31, Sichuan
Chlorophyllum globosum	3	14	0	0	June 3 to Aug 20, Sichuan
Chlorophyllum hortense and *Clitocybe* sp.[P]	1	1	0	0	Oct 26, Sichuan
Chlorophyllum molybdites	152	302	0	0	Mar 28 to Oct 20, Hunan, Guangxi, Zhejiang, Anhui, Sichuan, Hubei, Yunnan, Chongqing, Jiangxi, Hainan, Henan, Guangdong, Fujian, Guizhou, and Jiangsu
Chlorophyllum molybdites and *Ch. hortense*[G]	1	1	0	0	Sept 13, Hunan
Chlorophyllum molybdites and *Entoloma omiense*[G]	1	1	0	0	Sept 28, Hunan
Chlorophyllum spp.	3	9	0	0	July 31 to Dec 14, Sichuan, Hunan, and Guangdong
Cortinarius sinensis.[E] and *C. fulminoides*[U] (bought from market)	1	4	0	0	Sept 8, Ningxia
Entoloma caespitosum	1	1	0	0	Sept 20, Hunan
Entoloma omiense	28	49	0	0	June 28 to Oct 9, Hunan, Zhejiang, Hainan, and Fujian
Entoloma omiense, Entoloma sp[U] and *Psathyrella candolleana*[G/P]	1	1	0	0	July 8, Hunan
Entoloma omiense and *Micropsalliota* sp[U]	1	3	0	0	Sept 10, Fujian
Entoloma omiense and *Suillus placidus*[G]	1	4	0	0	Sept 17, Guizhou
Entoloma cf. *rhodopolium*	1	5	0	0	Aug 4, Yunnan
Entoloma cf. *sinuatum*	2	4	0	0	Sept 14 to 21, Guizhou
Entoloma spp.	17	51	0	0	June 5 to Oct 18, Guangxi, Guizhou, Hunan, and Yunnan
Gerhardtia sinensis	4	13	0	0	Oct 7 to 11, Hunan
Gymnopus densilamellatus	3	19	0	0	Feb 12 to May 31, Hunan and Guizhou
Hygrophorus cf. *whitei*[U], *Lycoperdon caudatum*[U] and *Megacollybia marginata*[U]	1	5	0	0	Oct 9, Sichuan
Hypholoma fasciculare	3	9	0	0	July 8 to Dec 4, Sichuan and Yunnan
Lactarius subhirtipes	3	9	0	0	May 31 to July 26, Hunan, Guizhou, and Anhui
Lactifluus deceptivus, *Lf. pilosus*[G], *Lf.* aff. *piperatus*[G] and ***Lf. puberulus***[G] (dried mushrooms)	1	2	0	0	Feb 9, Hunan
Lactifluus pseudoluteopus[U]	1	5	0	0	Aug 23, Yunnan
Leucocoprinus cretaceous and *Lc. cepistipes*[G]	1	2	0	0	Sept 13, Hunan
Marasmius maximus[E] and *Mycena* sp.[U]	1	1	0	0	July 18, Hubei
Melanoleuca griseobrunnea[U]	1	2	0	0	May 12, Zhejiang
Micropsalliota furfuracea	1	2	0	0	Sept 14, Hunan

Continued

Mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Micropsalliota sp.[U], *Hortiboletus rubellus*[E] and *Russula pectinatoides*[E]	1	2	0	0	Sept 24, Hunan
Neoboletus venenatus (patients of two incidents ate dried mushrooms, bought from market)	4	9	0	0	Aug 13 to Sept 24, Xizang, Guangdong, Hunan, and Sichuan
Neoboletus venenatus and *Scleroderma bovista*[G] (dried mushrooms, bought from market)	1	2	0	0	June 18, Hunan
Neonothopanus* aff. *nambi	2	4	0	0	May 13 to July 13, Yunnan
Omphalotus guepiniformis	2	10	0	0	May 28, Guangxi; Oct 4, Hunan
Omphalotus olearius	2	16	0	0	Sept 9 to Nov 16, Yunnan
Pholiota multicingulata	2	9	0	0	Sept 22 to Oct 5, Hunan
Pulveroboletus subrufus, *Russula punctipes*[G], *Chiua virens*[G] and *Suillus pinetorum*[G]	1	2	0	0	Dec 6, Guizhou
Rubroboletus sinicus and *Neoboletus* cf. *multipunctatus*[U]	1	4	0	0	July 28, Guizhou
Rubroboletus sinicus and *Retiboletus fuscus*[E]	1	3	0	0	June 18, Yunnan
Rubroboletus sp.[U]	1	2	0	0	July 25, Hunan
Russula viridicinnamomea[E], *Agaricus* sp.[U], *Termitomyces microcarpus*[E] and *Lactarius vividus*[E]	1	5	0	0	Aug 2, Sichuan
Russula rufobasalis	1	1	0	0	June 10, Hunan
Russula rufobasalis, ***Lactarius atromarginatus***[G], *Amanita fritillaria*[G/P] and *Russula citrina*[U]	1	2	0	0	June 11, Hunan
Russula rufobasalis, *Amanita fritillaria*[G/P], *Russula compacta*[E], *R. nigricans*[E], *R. subatropurpurea*[E], *R.* cf. *fragrantissima*[U], and *Cortinarius purpurascens*[U]	1	2	0	0	June 11, Hunan
Russula grata, R. cf. *subfoetens*[G], *Lactifluus* aff. *glaucescens*[G], *R. fragrantissima*[U], *R. pseudoamoenicolor*[U], *R. sarnarii*[U], *R. cyanoxantha*[E], *R. variata*[E], *R. vesca*[E], *R. virescens*[E] and *Entoloma* cf. *undatum*[U] (dried mushrooms, bought from market)	1	3	0	0	Feb 5, Hunan
Russula japonica	58	151	0	0	May 31 to Oct 15, Hunan, Zhejiang, Chongqing, Anhui, Yunnan, Guizhou, Fujian, and Hubei
Russula japonica, Entoloma omiense[G] and *Agaricus* sp.[U]	1	3	0	0	Oct 5, Hunan
Russula japonica, R. cerolens[E], *Leotia lubrica*[U] and *Phylloporus dimorphus*[E]	1	2	0	0	July 11, Guizhou
Russula japonica and *R. foetens*[G]	1	1	0	0	June 15, Hunan
Russula japonica and *R. sanguinea*[G]	1	3	0	0	June 10, Hunan
Russula japonica and *R. puncitpes*[G]	1	3	0	0	Oct 3, Hunan
Scleroderma areolatum	1	12	0	0	Aug 12, Beijing
Scleroderma cepa	4	11	0	0	July 7 to Sept 27, Yunnan, Sichuan, Hunan, and Chongqing
Scleroderma citrinum	1	1	0	0	Oct 13, Hunan
Suillus granulatus (dried mushrooms, bought from market)	1	2	0	0	Mar 23, Ningxia
Suillus granulatus, Amanita sinocitrina[P], *A. griseofolia*[G/P], *Russula* spp.[U], *Lycoperdon* sp.[U] and *Gymnopus* sp.[U]	1	1	0	0	Sept 24, Hunan
Suillus pinetorum	1	8	0	0	July 21, Yunnan
Thicholoma highlandense	1	2	0	0	Nov 13, Yunnan
Tricholoma sinopardinum, T. sinoportentosum[E], *Lactarius deterrimus*[E] and *Agaricus* sp.[U]	1	3	0	0	July 21, Sichuan

Continued

Mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Tricholoma stans	1	6	0	0	Nov 14, Yunnan
Tylopilus neofelleus	1	1	0	0	Aug 9 to Sept 27, Yunnan and Chongqing
Psycho-neurological disorder					
Amanita griseopantherina and *Russula foetens*[G]	1	12	0	0	July 21, Sichuan
Amanita melleiceps	5	20	0	0	May 30 to Sept 15, Hunan and Guangxi
Amanita orientigemmata	1	1	0	0	Sept 23, Hunan
Amanita orsonii, A. pseudovaginata[U] and *Entoloma* cf. *subcorvinum*[U]	1	2	0	0	June 28, Guizhou
Amanita rufoferruginea	6	18	0	0	June 6 to Aug 6, Hunan, Chongqing, and Sichuan
Amanita cf. *subfrostiana*	1	2	0	0	July 21, Yunnan
Amanita subglobosa	17	49	0	0	June 19 to Sept 24, Guizhou, Anhui, Chongqing, Sichuan, Yunnan, and Hunan
Amanita sychnopyramis f. *subannulata*	4	42	0	0	Apr 26 to June 10, Hainan, Guangxi, and Hunan
Butyriboletus roseoflavus (bought from market, maybe from Yunnan)	1	9	0	0	Nov 5, Hainan
Clitocybe dealbata	1	2	0	0	July 15, Yunnan
Clitocybe subditopoda	1	3	0	0	Oct 5, Guizhou
Gymnopilus dilepis	6	13	0	0	June 21 to Sept 23, Sichuan, Yunnan, and Guizhou
Gymnopilus spp.	5	8	0	0	May 9 to Oct 3, Jiangxi, Hubei, Hunan, and Yunnan
Gyromitra venenata	2	4	0	0	Mar 13 to 21, Guizhou, Yunnan
Inocybe* aff. *ericetorum and *Russula insignis*[G]	1	1	0	0	May 26, Hunan
Inocybe serotina	1	2	0	0	Sept 19, Ningxia
Inocybe serotina and ***Mallocybe fulvipes***[P]	1	1	0	0	Sept 2, Ningxia
Inocybe serotina and *Pseudosperma umbrinellum*[P] = *Inocybe umbrinella*	1	4	0	0	Aug 28, Ningxia
Inocybe splendentoides	1	1	0	0	Oct 7, Beijing
Inosperma* aff. *virosum	2	16	0	0	Sept 9 to 16, Yunnan
Inosperma* cf. *virosum	1	5	0	0	May 9, Hainan
Lanmaoa asiatica	1	4	0	0	July 19, Yunnan
Lanmaoa asiatica, Rubroboletus latisporus[G], *Suillus granulatus*[G], *Caloboletus xiangtoushanensis*[U] and *Imperator* sp.[U] (dried mushrooms, from Chongqing)	1	3	0	0	Aug 27, Guangdong
Lanmaoa asiatica, Rubroboletus latisporus[G], *Tylopilus neofelleus*[G], *Neoboletus* sp.[U] and *Sutorius* aff. *eximius*[G] (dried mushrooms, from Chongqing)	1	3	0	0	Oct 13, Zhejiang
Panaeolus fimicola	1	2	0	0	June 30, Shandong
Pseudosperma* cf. *bulbosissimum	1	4	0	0	Oct 5, Ningxia
Pseudosperma umbrinellum, ***Mallocybe siciliana***[P] = *Inocybe siciliana, Hebeloma dunense*[U] and *Psathyrella candolleana*[G/P]	1	4	0	0	Sept 4, Hebei
Pseudosperma yunnanense	1	1	0	0	July 10, Yunnan
Psilocybe cubensis	1	2	0	0	Nov 27, Hunan
Shiitake mushroom dermatitis					
Lentinula edodes[E]	1	1	0	0	Jan 5, Jiangxi

Continued

Mushroom species	Number of incidents	Number of patients	Deaths	Case fatality (%)	Spatial and temporal distribution
Unclassified					
Agaricus blazei[E]	1	2	0	0	Aug 25, Yunnan
Amanita cf. *constricta* and *Entoloma* cf. *piceinum*[U]	1	5	0	0	Aug 7, Sichuan
Amanita griseofolia	1	4	0	0	June 27, Guizhou
Butyriboletus yicibus[E] (from Yunnan)	1	4	0	0	July 26, Hunan
Coprinopsis nivea[E]	1	3	0	0	June 29, Hunan
Coprinus comatus[E]	2	3	0	0	Early August to Oct 25, Beijing and Ningxia
Cortinarius sinensis.[E] (bought from market)	1	2	0	0	Sept 24, Ningxia
Lactarius cinnamomeus[E]	1	2	0	0	Mar 14, Hunan
Lactifluus tenuicystidiatus[E]	1	2	0	0	Aug 25, Yunnan
Panus gigianteus[E]	1	4	0	0	Sept 20, Hunan
Panus tigrinus[E]	1	1	0	0	May 16, Yunnan
Pleurotus ostreatus[E]	1	1	0	0	Oct 31, Ningxia
Retiboletus fuscus[E] (dried mushrooms, from Yunnan)	1	2	0	0	Mar 6, Fujian
Russula cf. *viridicinnamomea*[E]	1	4	0	0	July 29, Fujian
Scleroderma yunnanense[E]	3	7	0	0	June 25 to Sept 15, Hunan, Yunnan, and Fujian
Stropharia rugosoannulata[E]	1	1	0	0	Jan 31, Guizhou
Xerocomus parvulus[E]	1	4	0	0	Sept 28, Hunan

Abbreviations: ALF=Acute liver failure, ARF=Acute renal failure, G= Gastroenteritis, P= Psycho to neurological disorder, U=Unclassified, E=edible.

Note: Species newly recorded as poisonous mushrooms in China are in bold.

Preplanned Studies

Different Percentile Regression of Blood Glucose Among Adolescents Aged 12–20 — United States, 1999–2018

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Summary

What is already known on this topic?

The incidence of diabetes is on the rise in the world, and it is increasingly affecting young people. The American Diabetes Association (ADA) has published the 2020 Diabetes Medical Standard, but there is no blood glucose standard for teenagers by age and sex.

What is added by this report?

In this study, quantile regression was used to analyze the data of National Health and Nutrition Examination Survey (NHANES) and found that blood glucose varied significantly based on demographics.

What are the implications for public health practice?

This study provides reference for formulating the normal ranges of adolescent blood glucose and helping to screen out high-risk groups at an early stage for key interventions. The quantile regression method can give a set of curves, which could better describe the situation.

As the burden of disease increases, there is a growing awareness of the dangers of elevated blood glucose (*1*). The incidence of diabetes among adolescents is increasing year over year, and the average annual growth rate of diabetes among children and adolescents in the United States is 2.3%. Elevated blood glucose has many hazards if not treated in time and regularly as it will not only affect the growth and development of children but also cause complications such as diabetic ketoacidosis and cataracts. In severe cases, it can lead to blindness and psychological disorders for children (*2*). Obesity is thought to be the catalyst for diabetes which can lead to an increase in blood glucose in individuals. A close relationship has been observed in recent decades between rising rates of obesity and an increased incidence of type-2 diabetes among adolescents (*3*–*4*). In the 2020 diabetes medical standard published by the American Diabetes Association (ADA), Body Mass Index (BMI) is the primary risk factor in the screening and diagnosis of adolescent type-2 diabetes (*5*). This paper used the blood glucose data of 7,786 adolescents aged 12–20 years from 1999 to 2018 of the National Health and Nutrition Examination Survey (NHANES). Quantile regression was used to analyze the blood glucose of adolescents to explore the influence of gender on blood glucose under different quantiles. At the same time, the results of model correction of BMI were also analyzed. The blood glucose of the female 15-year-old group was close to the normal distribution, and the blood glucose of adolescents of men and women of other ages did meet the normal distribution and was not suitable for typical linear regression analysis. The regression coefficients of gender factors in different ages and quantiles were obtained through the two models and revealed that male blood glucose was higher than female blood glucose and all age groups were statistically significant (P<0.05). A picture of regression coefficients based on different scales showed a downward trend in regression coefficient with the increase of age. There is an urgent need to set up standards for adolescent blood glucose according to various ages and genders.

The NHANES is a sustained survey project implemented by the US CDC since 1999, which uses a much more complex stage probability sampling to sample the American population (*6*–*7*). A cycle takes two years and is designed to assess the health and nutritional status of adults and children in the United States. The data of the project is free to the public, and no additional ethics application is required. In this study, the blood glucose data of 12–20 years old adolescents from 1999 to 2018 in NHANES was used for analysis, and 7,786 individuals had suitable data.

The statistical analysis was carried out with SAS software package (version 9.4, 100 SAS Campus Drive Cary, NC 27513). Quantile regression does not require the distribution of data but requires the minimization of residual error. Different estimators of regression coefficients under different quantiles reflect that explanatory variables have different effects on different levels of explanatory variables. Quantile regression integrates the concept of the quantile into ordinary linear regression. However, the conclusion no longer only reflects the central position but can reflect the whole distribution situation. Model one was a single factor quantile regression analysis without any controlling factors, and model two was a multivariate quantile regression analysis after controlling BMI.

According to ADA's medical standards for diabetes in 2020, the normal range of adult blood glucose is 70–100 mg/dL. In this dataset, the blood glucose level in the 1st percentile was 72 mg/dL, the 85th percentile was 100 mg/dL, and their middle position was in the 42nd percentile. Therefore, the regression equation was established at the five percentiles of P_1, P_{42}, P_{50}, P_{85}, and P_{90}, and the partial regression coefficients under different quantile regression were recorded. The inspection level α was set to 0.05.

The analysis showed that for adolescents aged 12–20 years, the distribution of blood glucose levels at different ages varied (Table 1). By analyzing the regression coefficients of gender factors at different ages and different quantiles, gender factors in each age group of 12–20 years old were found to be statistically significant except in the P_1, and the blood glucose level were higher in males than in females. After controlling for BMI, Model two found that the decrease in blood glucose levels was inconsistent with Model 1, such that for the 12-year-old age group, the regression coefficients for gender of Model 1 and Model 2 at P_{42} were –2.7 and –3.1, respectively; at P_{50}, the gender factor was –2.8 and –3.07, respectively; and at P_{85}, the gender factor was –4.0 and –4.1, respectively (Table 2). Other age groups also show the same phenomenon.

DISCUSSION

A set of curves obtained by quantile regression can provide enough information to study the complete picture of conditional distribution of dependent variables. This study found different genders had statistically significant effects on blood glucose at different percentiles, and blood glucose levels were different at different ages using percentile regression analysis. This suggests that the study of adolescent blood glucose or the preparation of adolescent blood glucose standards should be adjusted based on age and gender.

The prevalence of global juvenile diabetes has been increasing dramatically, especially during the past three or four decades, leading to a global epidemic that leaves diabetes as one of the most common and serious diseases facing humans (*8*). Some studies (*9*) showed that the fasting blood glucose level of boys was higher than that of girls (P<0.05), and there were some differences in the fasting blood glucose level of different age groups (P<0.001). Zhao et al. also pointed out that gender had a certain impact on the correlation between blood glucose and blood lipids (*10*), and patients of different genders should be targeted to monitor and control blood glucose levels. Hou et al. proposed in 2016 that adolescent obesity increased the risk of glycosylated hemoglobin for the diagnosis of diabetes in adulthood after adjusting for and controlling for

TABLE 1. Different percentiles of blood glucose in American teenagers aged 12–20 years.

Age (years)	Total				Male				Female			
	n	P_{25}	P_{50}	P_{75}	n1	P_{25}	P_{50}	P_{75}	n2	P_{25}	P_{50}	P_{75}
12	1,001	88.5	93.7	98.0	463	90.0	95.0	99.7	538	87.7	92.3	96.4
13	914	88.0	93.0	98.0	466	90.0	95.0	99.5	448	86.2	92.0	96.0
14	902	87.8	92.1	97.3	407	89.2	95.0	100.0	495	86.0	90.3	95.0
15	838	87.0	92.0	97.0	419	89.7	95.0	99.0	419	85.0	89.5	94.4
16	1,032	86.0	91.0	97.0	481	89.0	95.0	99.0	551	83.0	98.0	93.0
17	934	86.0	91.0	96.0	465	87.3	93.0	98.0	469	85.0	89.4	93.9
18	909	86.2	92.0	97.0	502	88.0	93.0	98.8	407	84.8	90.0	95.0
19	873	87.0	91.6	97.1	456	89.3	94.0	99.7	417	84.7	89.0	94.2
20	383	85.3	91.0	97.0	181	89.0	95.0	102.3	202	83.7	88.5	93.0
12–20	7,786	87.0	92.0	97.0	3,840	89.0	94.0	99.0	3,946	85.0	90.0	95.0

Note: P_{25}, P_{50} and P_{75} represent the 25th, 50th, and 75th percentiles, respectively. The unit of blood glucose level in each percentile in the table is mg/dL

TABLE 2. Regression coefficient of gender factors of American teenagers aged 12–20 under different ages and quantiles.

Age (years)	Quantile (Model 1 *)							Quantile (Model 2 †)						
	P_{1} (95% CI)	P_{25} (95% CI)	P_{42} (95% CI)	P_{50} (95% CI)	P_{75} (95% CI)	P_{85} (95% CI)	P_{90} (95% CI)	P_{1} (95% CI)	P_{25} (95% CI)	P_{42} (95% CI)	P_{50} (95% CI)	P_{75} (95% CI)	P_{85} (95% CI)	P_{90} (95% CI)
12	−1.3 (−12.2, 9.6)	−2.3 (−3.5, −1.1)	−2.7 (−3.7, −1.7)	−2.8 (−3.9, −1.7)	−3.3 (−4.6, −2.1)	−4 (−5.6, −2.4)	−4.2 (−5.7, −2.7)	−2.5 (−13.4, 8.3)	−2.7 (−4.1, −1. 3)	−3.1 (−4.2, −2)	−3.0 (−4.2, −1.8)	−3.3 (−4.5, −2.1)	−4.1 (−5.8, −2.4)	−4.5 (−6.3, −2.8)
13	−0.2 (−5.7, 5.3)	−3.8 (−5.1, −2.5)	−3.5 (−4.7, −2.3)	−4.0 (−5.2, −2.8)	−3.5 (−5.0, −2.0)	−3.6 (−5.4, −1.8)	−4.1 (−6, −2.2)	−5.5 (−9.7, −1.3)	−4.4 (−6.0, −2.7)	−3.5 (−4.9, −2.2)	−3.7 (−4.9, −2.4)	−3.1 (−4.5, −1.7)	−3.6 (−5.4, −1.8)	−4.1 (−6.5, −1.7)
14	−6.0 (−17.9, 5.9)	−3.2 (−4.3, −2.1)	−4.1 (−5.3, −2.9)	−4.7 (−5.8, −3.6)	−5.0 (−6.3, −3.7)	−4.8 (−6.3, −3.3)	−4.1 (−6.6, −1.6)	−4.5 (−13.2, 4.2)	−3.3 (−4.3, −2.3)	−4.4 (−5.5, −3.4)	−4.7 (−6.1, −3.3)	−4.4 (−5.8, −3.0)	−4.7 (−6.3, −3.2)	−5.0 (−7.2, −2.8)
15	−4.3 (−13.4, 4.8)	−4.7 (−6.3, −3.1)	−5.2 (−6.6, −3.8)	−5.5 (−6.7, −4.3)	−4.6 (−5.8, −3.4)	−5.0 (−7.2, −2.8)	−5.0 (−6.9, −3.1)	−7.0 (−14.9, 1.0)	−4.3 (−5.9, −2.7)	−5.4 (−6.7, −4.2)	−5.7 (−6.8, −4.5)	−4.9 (−6.2, −3.7)	−5.3 (−7, −3.7)	−5.5 (−8.1, −2.9)
16	−8.3 (−17.6, 1.0)	−6.0 (−7.8, −4.2)	−5.5 (−6.8, −4.2)	−5.6 (−6.8, −4.4)	−6.0 (−7.2, −4.9)	−6 (−7.9, −4.1)	−6.5 (−8.2, −4.8)	−6.8 (−15.5, 1.9)	−6.4 (−7.9, −4.8)	−5.1 (−6, −4.2)	−5.5 (−6.7, −4.4)	−6.4 (−7.4, −5.4)	−5.5 (−7.5, −3.6)	−5.9 (−7.2, −4.5)
17	0.3 (−7.2, 7.8)	−2.3 (−4.0, −0.7)	−3.1 (−4.3, −1.9)	−3.6 (−4.3, −2.9)	−4.1 (−5.8, −2. 5)	−4.6 (−6.1, −3.1)	−4.8 (−6.6, −3)	−1.4 (−7.7, 4.9)	−3.0 (−4.3, −1.6)	−3.3 (−4.6, −2)	−3.3 (−4.3, −2.3)	−4.0 (−5.7, −2.3)	−4.7 (−6.4, −2.9)	−4.9 (−7.5, −2.4)
18	−6.3 (−16.1, 3.5)	−3.2 (−4.9, −1.5)	−3.6 (−4.7, −2.5)	−3.4 (−4.5, −2.3)	−3.8 (−5.2, −2.4)	−4.0 (−5.9, −2.1)	−4.0 (−6.3, −1.7)	−6.8 (−17, 3.4)	−3.8 (−5.2, −2.4)	−3.2 (−4.3, −2.1)	−3.2 (−4.6, −1.9)	−4.1 (−5.7, −2.4)	−4.4 (−5.9, −2.9)	−4.0 (−6.9, −1.1)
19	−6.5 (−14.8, 1.8)	−4.5 (−5.8, −3.2)	−4.5 (−5.8, −3.2)	−5.0 (−6.5, −3.5)	−5.5 (−6.8, −4.2)	−4.0 (−6.2, −1.8)	−5.0 (−7.5, −2.5)	−3.6 (−9.1, 1.8)	−4.5 (−5. 9, −3.1)	−4.9 (−6, −3.8)	−5.1 (−6.6, −3.7)	−4.5 (−6.1, −2.9)	−5.1 (−6.8, −3.4)	−4.8 (−7.2, −2.3)
20	2.9 (−35.3, 41.1)	−5.3 (−7.2, −3.4)	−7.0 (−9.8, −4.2)	−6.7 (−9, −4.4)	−9.0 (−12.0, −6.0)	−9.0 (−11.2, −6.8)	−9.3 (−13.9, −4.7)	1.0 (−24.6, 26.5)	−4.9 (−7.0, −2.7)	−6.3 (−8.4, −4.2)	−7.1 (−9, −5.1)	−8.5 (−10.7, −6.3)	−8.6 (−11.3, −5.9)	−7.9 (−10.1, −5.8)
12−20	−1.9 (−4.2, 0.4)	−3.6 (−7.2, −3.1)	−4.3 (−4.9, −3.8)	−4.0 (−4.3, −3.7)	−4.0 (−4.4, −3.6)	−4.4 (−5.3, −3.5)	−4.7 (−5.8, −3.6)	−2.6 (−4.9, −0.3)	−3.9 (−4.4, −3.5)	−4.3 (−4.7, −3.9)	−4.4 (−4.9, −4)	−4.4 (−4.9, −4.0)	−4.6 (−5.3−3.9)	−5.3 (−6.1−4.5)

* Model 1: Single factor analysis;

† Model 2: adjusting for BMI;

Notes: 1) The regression coefficient in this table means the change value of blood sugar when males compared with females

2) If the range of 95%CI includes 0, there is no statistical significance; If the range of 95%CI does not include 0, it is statistically significant.

confounders [(OR (95% CI): 5.93 (3.06–1.49)] (*11*). The conclusion is that obesity from adolescence to adulthood is a risk factor for adult diabetes, and controlling adolescent obesity is highly necessary for the early prevention and treatment of diabetes.

This study was subject to some limitations. The dataset had possible limitations due to the historicity and purpose of the data and also potentially due to some incompleteness in data disclosure. Furthermore, blood glucose is influenced by more factors beyond age and gender, such as race, nationality, lifestyle, genetic background, as well as sample size and quality control during data collection.

Adolescent obesity is of high clinical and public health importance for glycemic impact. Strengthening the detection of blood glucose and blood lipids in overweight and obese children and taking comprehensive intervention measures as early as possible will benefit children's health and reduce the incidence of diabetes. Standards need to be established for adolescent blood glucose and adjusted according to different ages and genders.

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REFERENCES

1. Power C, Thomas C. Changes in BMI, duration of overweight and obesity, and glucose metabolism: 45 years of follow-up of a birth cohort. Diabetes Care 2011;34(9):1986 – 91. http://dx.doi.org/10.2337/dc10-1482.
2. Liang YQ, Zheng YT, Fan N. Application effect of 4R crisis management in blood glucose management of children with diabetes mellitus. Today Nurse 2020;27(6):64 – 6. http://dx.doi.org/10.19792/j.cnki.1006-6411.2020.17.028. (In Chinese).
3. SEARCH for Diabetes in Youth Study Group, Liese AD, D'Agostino Jr RB, Hamman RF, Kilgo PD, Lawrence JM, et al. The burden of diabetes mellitus among US youth: prevalence estimates from the SEARCH for Diabetes in Youth Study. Pediatrics 2006;118(4):1510 – 8. http://dx.doi.org/10.1542/peds.2006-0690.
4. TODAY Study Group, Zeitler P, Hirst K, Pyle L, Linder B, Copeland K, et al. A clinical trial to maintain glycemic control in youth with type 2 diabetes. N Engl J Med 2012;366(24):2247 – 56. http://dx.doi.org/10.1056/NEJMoa1109333.
5. American Diabetes Association. 13. Children and adolescents: *standards of medical care in diabetes-2020*. Diabetes Care 2020;43(S1):S163 – 82. http://dx.doi.org/10.2337/dc20-S013.
6. Zipf G, Chiappa M, Porter KS, Ostchega Y, Lewis BG, Dostal J. National health and nutrition examination survey: plan and operations, 1999-2010. Vital Health Stat 2013;(56):1-37. https://www.cdc.gov/nchs/data/series/sr_01/sr01_056.pdf.
7. Ahluwalia N, Dwyer J, Terry A, Moshfegh A, Johnson C. Update on NHANES dietary data: focus on collection, release, analytical considerations, and uses to inform public policy. Adv Nutr 2016;7(1):121 – 34. http://dx.doi.org/10.3945/an.115.009258.
8. Polonsky KS. The past 200 years in diabetes. N Engl J Med 2012;367(14):1332 – 40. http://dx.doi.org/10.1056/NEJMra1110560.
9. Wen ZG, Yu Q, Xiao SM. Study and analysis of current status of adolescent blood glucose in teenagers and its influencing factors. Mod Hosp 2019;19(7):1009 – 14,1024. http://dx.doi.org/10.3969/j.issn.1671-332X.2019.07.021. (In Chinese).
10. Zhao C, Li N, Bai XW, Guo WH, Li HM. Influence of gender on the correlation between blood glucose level and serum lipids in patients with type 2 diabetes mellitus. Hebei Med J 2019;41(3):414 – 7. http://dx.doi.org/10.3969/j.issn.1002-7386.2019.03.022. (In Chinese).
11. Hou DQ, Zhao XY, Liu JT, Chen FF, Yan YK, Cheng H, et al. Correlation analysis between obesity and adult diabetes in children and adolescents. Chin J Prev Med 2016;50(1):23 – 7. http://dx.doi.org/10.3760/cma.j.issn.0253-9624.2016.01.005. (In Chinese).

Preplanned Studies

The Distribution of Pregnant Women with Different Pregnancy Risks — 4 Cities, China, 2019

Yanhui Liu[1]; Rong Luo[1]; Aiqun Huang[1,#]

Summary

What is already known on this topic?

Based on different pregnancy risk levels, the implementation of the "Five-Color Management" for pregnant women can prevent adverse pregnancy outcomes and ensure the safety of mothers and infants.

What is added by this report?

The proportions of being multipara and of advanced maternal age in the 4 cities (Beijing, Chengdu, Shenzhen, and Wuhan) were 47.4% and 13.3%, respectively. The proportions of "Yellow and above" pregnancy risk ranged from 54.5% to 65.0% and ranged from 7.4% to 16.3% for "Orange and above" pregnancy risk. Among women with "Orange and above" pregnancy risk, most of them gave birth in public tertiary institutions (71.8%–79.4%).

What are the implications for public health practice?

The implementation of the "Five-Color Management" for pregnant women with different pregnancy risks should be strengthened, especially those with "Orange and red" pregnancy risk who should be hospitalized for delivery in tertiary medical institutions if they have conditions.

In October 2015, China's One-Child Policy was replaced by a universal Two-Child Policy; following the policy change, multiparous births exceeded primiparous births nationwide (*1*). From July 2016 to December 2017, the monthly mean percentage of being multipara and being of advanced maternal age (aged 35 years and over) increased by 9.1% and 5.8%, respectively, and this increase was also seen in at-risk pregnant women (*2*). The comprehensive high-risk score method for pregnant women was used to screen pregnancy risks, but the screening results were untargeted and disorganized (*3*). In order to prevent adverse pregnancy outcomes and ensure the safety of mothers and infants, the National Health Commission (NHC) of China in 2017 proposed implementing the "Five-Color Management" for women during pregnancy and 42-days postpartum based on different pregnancy risk levels (*4*). Compared with the traditional comprehensive high-risk score method, the "Five-Color Management" for pregnant women is to screen, assess, classify, and manage pregnancy risks from a thematic perspective (*5*). We conducted this study based on surveillance projects from 4 cities (Beijing, Chengdu, Shenzhen, and Wuhan) in China from 2014 to 2019. This study aims to analyze the implementation of the "Five-Color Management" in 2019 in the 4 cities. The results showed that the proportions of "Yellow and above" pregnancy risk ranged from 54.5% to 65.0% and ranged from 7.4% to 16.3% for "Orange and above" pregnancy risk. Among women with "Orange and above" pregnancy risk, most of them gave birth in public tertiary institutions (71.8%–79.4%).

The data were collected from the surveillance project that was founded by the China-World Health Organization Biennial Collaborative Projects entitled "Surveillance of high-risk maternal health services and management" (2018–2019). The surveillance project was implemented by the National Center for Women and Children's Health of China CDC, and its details were described in our previous publications (*6*–*7*). Briefly, three cities including Chengdu, Wuhan, and Shenzhen were selected for the surveillance from the western, central, and eastern regions of China, respectively. These cities were selected based on their geographical location, and the existing city-wide unified reporting system for maternal and child health (MCH) covering the whole city. Furthermore, these criteria were used to select two districts (Haidian District and Chaoyang District) in Beijing to represent the northern region of China. The surveillance covered all medical institutions providing childbirth services in the 4 cities, including general hospitals, maternal and children's healthcare hospitals, specialized hospitals, community health centers/township hospitals, and private hospitals. In 2019, a total of 325 medical institutions were covered in the surveillance.

According to national regulations, the "Five-Color

Management" requires that pregnant women be classified into five colors levels — green, yellow, orange, red, and purple — according to their basic conditions and pregnancy complications (*4–5*). "Green" indicates normal pregnancy; "Yellow" indicates general risk and that pregnancy complications are mild and stable; "Orange" indicates medium risk and that pregnancy complications pose a threat to mother and infant safety; "Red" indicates high risk and that pregnant women suffer from serious pregnancy complications, continued pregnancy may endanger the life of mother and infant; and "Purple" indicates that the pregnant women have infectious diseases such as viral hepatitis, syphilis, HIV/AIDS, tuberculosis, serious infectious pneumonia, or a specific viral infection (H1N7, Zika, etc.). Except for the combination of "Purple" and other color levels, pregnant women will be managed according to their "color level" with the highest pregnancy risks. "Yellow and above" was classified as high-risk pregnancy, and "Orange or above" was classified as key groups of high-risk pregnancy. In the 4 cities, the MCH information system covered the whole city, and individual antenatal care and delivery information for all pregnant women were recorded in the system. Due to the adjustment of the MCH information system, the analysis of the "Five-Color Management" only covered pregnant women from July 1 to December 31, 2019 in Wuhan, while in the other 3 cities included all pregnant women during 2019.

Among 625,305 pregnant women in the 4 cities, the proportions of being multipara and of advanced maternal age were 47.4% and 13.3%, respectively. The proportion of being of advanced maternal age in multipara (21.8%) was higher than that in primipara (5.7%). (Table 1)

In the 4 cities, the proportion of "Yellow" pregnancy risk was between 48.1% and 62.1%, and the proportion of "Orange" and "Red" pregnancy risk was the highest in Beijing (14.5%) and the lowest in Wuhan (6.3%). The proportion of "Yellow and above" pregnancy risk (high-risk pregnancy) ranged from 54.5% to 71.4%, and "Orange and above" pregnancy risk (the key groups of high-risk pregnancy) ranged from 7.4% to 16.3%. (Table 2)

In the 4 cities, the proportion of pregnant women giving birth in public tertiary institutions was between 65.9% to 76.9%, and the proportion giving birth in public secondary institutions or other institutions were between 11.2% to 18.6%. More than 82.0% of pregnant women with "Yellow" risk gave birth in public secondary or above institutions, and 71.8% to 79.4% of pregnant women with "Orange and above" risk gave birth in public tertiary institutions. However,

TABLE 1. The number and proportions of multipara and advanced maternal age in 4 cities in China, 2019.

Cities	Pregnant women (N)	Primipara (N/%)	Multipara (N/%)	Advanced maternal age		
				Total (N/%)	Primipara (N/%)	Multipara (N/%)
Beijing	84,403	54,774 (64.9)	29,629 (35.1)	17,317 (20.5)	6,306 (11.5)	11,011 (37.2)
Chengdu	214,554	115,744 (53.9)	98,810 (46.1)	19,998 (9.3)	4,285 (3.7)	15,713 (15.9)
Shenzhen	208,167	90,713 (43.6)	117,454 (56.4)	31,744 (15.2)	5,060 (5.6)	26,684 (22.7)
Wuhan	118,181	67,408 (57.0)	50,773 (43.0)	14,284 (12.1)	2,970 (4.4)	11,314 (22.3)
Total	625,305	328,639 (52.6)	296,666 (47.4)	83,343 (13.3)	18,621 (5.7)	64,722 (21.8)

TABLE 2. The distribution of different pregnancy risks according to color levels in 4 cities in China, 2019.

Cities	Different pregnancy risks* (N/%)					Yellow and above (N/%)	Orange and above (N/%)
	Green	Yellow	Orange	Red	Purple		
Beijing	28,935 (34.3)	42,801 (50.7)	11,165 (13.2)	1,078 (1.3)	1,761 (2.1)	55,468 (65.7)	13,729 (16.3)
Chengdu	74,972 (34.9)	123,301 (57.6)	15,171 (7.0)	384 (0.2)	2,372 (1.1)	139,582 (65.1)	17,671 (8.2)
Shenzhen	59,574 (28.6)	129,170 (62.1)	17,923 (8.6)	1,142 (0.5)	1,597 (0.8)	148,593 (71.4)	20,449 (9.8)
Wuhan†	28,068 (45.5)	29,679 (48.1)	3,548 (5.8)	300 (0.5)	811 (1.3)	33,616 (54.5)	4,537 (7.4)

* "Green" indicates normal pregnancy. "Yellow" indicates general risk and that pregnancy complications are mild and stable. "Orange" indicates medium risk and that pregnancy complications pose a threat to mother and infant's safety. "Red" indicates high risk and that pregnant women suffer from serious pregnancy complications, continued pregnancy may endanger the life of mother and infant. "Purple" indicates that the pregnant women had an infectious disease such as viral hepatitis, syphilis, HIV infection and AIDS, tuberculosis, serious infectious pneumonia, or a specific viral infection (H1N7, Zika, etc.).

† The analysis of the "Five-Color Management" in Wuhan only included pregnant women from July 1 to December 31, 2019.

more than 20% of pregnant women that had "Orange and above" risk gave birth in public secondary and below institutions. (Table 3)

DISCUSSION

The surveillance project carried out in 4 relatively developed cities of China in 2019 showed that the proportions of pregnant women with "Yellow and above" risk and "Orange and above" risk were higher and that most of them received the "Five-Color Management" based on different pregnancy risks. However, some pregnant women with higher risk still gave birth in lower-level institutions. Therefore, the implementation of the "Five-Color Management" for pregnant women with different risks should be further strengthened, especially for those with "Orange" and "Red" risk who should be hospitalized for delivery in tertiary medical institutions if they have conditions.

The literature showed that multipara and advanced maternal age were associated with increased pregnancy complications, in turn leading to maternal and fetal morbidity and mortality (*8*–*9*). In this study, the proportions of being multipara and of advanced maternal age in the 4 cities were 47.4% and 13.3%, respectively, which were basically consistent with the national levels in 2019 (49.9% and 15.8%, respectively) (*10*). Therefore, more attention should be paid to the "Five-Color Management" for pregnant women to improve the health of pregnant women that were multipara or of advanced maternal age and reduce maternal and perinatal mortality.

The NHC requires secondary and above medical institutions to assess and classify pregnancy risks for all pregnant women, and tertiary medical institutions to assess pregnancy suitability for "Red" pregnancy risk. "Yellow" pregnancy risk women are recommended to hospitalization for delivery in secondary or above institutions; "Orange and above" pregnancy risk should be hospitalized for delivery in tertiary institutions if they have conditions; "Purple" pregnancy risk should be managed according to the regulations on the prevention and treatment of infectious diseases (*4*–*5*). The pilot results showed that the "Five-Color Management" for pregnant women was effective in women accessing emergency obstetric care, especially for receipt of appropriate care once a medical institution is reached (*11*–*12*).

Our findings suggested the proportions of pregnant women with "Yellow and above" and "Orange and above" risk in our sample were higher than that in Guangdong Province in 2018 (42.2% and 6.9%, respectively) (*12*). Most pregnant women with different risk levels were hospitalized for delivery in appropriate level institutions, but there were still some pregnant women with higher risk levels that gave birth in lower-level institutions. In order to stabilize and reduce the pregnancy risk, antenatal care, follow-up management, and timely treatment of pregnancy

TABLE 3. The distribution of delivery with different pregnancy risks in 4 cities in China, 2019.

Cities	Institutions*	Different pregnancy risks (N/%)			Total (N/%)
		Green	Yellow	Orange and above	
Beijing	Public tertiary	21,232 (73.4)	24,520 (58.7)	9,862 (71.8)	55,614 (65.9)
	Public secondary	3,554 (12.3)	10,048 (24.1)	2,114 (15.4)	15,716 (18.6)
	Others	4,149 (14.3)	7,171 (17.2)	1,753 (12.8)	13,073 (15.5)
Chengdu	Public tertiary	55,969 (74.7)	85,152 (69.8)	13,937 (78.9)	155,058 (72.3)
	Public secondary	9,314 (12.4)	16,939 (13.9)	1,639 (9.3)	27,892 (13.0)
	Others	9,689 (12.9)	19,820 (16.3)	2,095 (11.9)	31,604 (14.7)
Shenzhen	Public tertiary	43,226 (72.1)	92,332 (72.1)	15,936 (79.4)	151,494 (72.8)
	Public secondary	8,512 (14.2)	16,702 (13.0)	2,048 (10.2)	27,262 (13.1)
	Others	8,206 (13.7)	19,110 (14.9)	2,095 (10.4)	29,411 (14.1)
Wuhan†	Public tertiary	21,297 (75.9)	22,707 (78.1)	3,415 (75.3)	47,419 (76.9)
	Public secondary	3,783 (13.5)	3,128 (10.8)	435 (9.6)	7,346 (11.9)
	Others	2,988 (10.6)	3,244 (11.2)	687 (15.1)	6,919 (11.2)

* Medical institutions providing childbirth services were divided into public tertiary, public secondary, and other institutions. Other institutions were all health facilities providing childbirth services except public tertiary and public secondary including public primary hospitals, private midwifery hospitals, etc.

† The analysis of the "Five-Color Management" in Wuhan only included pregnant women from July 1 to December 31, 2019.

complications should be strengthened. Therefore, medical institutions providing childbirth services should strengthen the implementation of the “Five-Color Management” for pregnant women, especially for pregnant women with “Orange” and “Red” risk levels who should be transferred to tertiary institutions for antenatal care and delivery.

This study were subject to certain limitations. First, the surveillance data were collected in 4 cities with an existing city-wide unified reporting system for MCH, so the results might not fully be representative of the regional and national levels. Second, there is no comparison between the results of the “Five-Color” classification and pregnancy outcomes. In the future, more studies should be taken to fix this issue that may have further value for antenatal care and hospital delivery.

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REFERENCES

1. Li PC, Liao ZJ, Wang C, Zhou YB, Li HT, Chen DJ, et al. Maternal characteristics and birth outcomes under different family planning policy. Chin J Reprod Health 2017;28(6):501 – 5. http://d.wanfangdata.com.cn/periodical/zgsyjkzz201706001. (In Chinese).
2. Li HT, Xue M, Hellerstein S, Cai Y, Gao YQ, Zhang YL, et al. Association of China’s universal two child policy with changes in births and birth related health factors: national, descriptive comparative study. BMJ 2019;366:l4680. http://dx.doi.org/10.1136/bmj.l4680.
3. Zhang SS, Huang T. Value of improved risk early warning and evaluation management on improving perinatal outcome of high-risk pregnant women. Chin Med Rec 2019;20(2):91 – 4. https://kns.cnki.net/KCMS/detail/detail.aspx?FileName=ZGBN201902032&DbName=CJFQ2019. (In Chinese).
4. National Health Commission of the People’s Republic of China. Regulations on pregnancy risk assessment and management (2017 No.35). http://www.nhc.gov.cn/fys/s3581/201711/9c3dc9b4a8494d9a94c02f890e5085b1.shtml. [2020-12-8]. (In Chinese).
5. National Health Commission of the People’s Republic of China. Notice on strengthening the work of safeguarding maternal and infant safety (2017 No.42). https://www.chinafpa.org.cn/zcfg/xgfg/201901/t20190125_42951.html. [2020-12-8]. (In Chinese).
6. Yan S, Huang AQ, Xu T, Hu HQ, Zhao W, Ma WX, et al. Analysis of obstetricians’ workload of institutions of maternal and children’s healthcare in some Chinese large and medium-sized cities. Chin J Reprod Health 2008;29(4):319 – 23. https://kns.cnki.net/KCMS/detail/detail.aspx?FileName=SYJK201804004&DbName=CJFQ2018. (In Chinese).
7. Huang AQ, Liu YH, Jin X. The impact of new adjustments to the family planning policy on the number of live births in four developed urban areas — China, 2013–2019. China CDC Wkly 2020;2(28): 530 – 3. http://weekly.chinacdc.cn/en/article/doi/10.46234/ccdcw2020.143.
8. Care AS, Bourque SL, Morton JS, Hjartarson EP, Davidge ST. Effect of advanced maternal age on pregnancy outcomes and vascular function in the rat. Hypertension 2015;65(6):1324 – 30. http://dx.doi.org/10.1161/HYPERTENSIONAHA.115.05167.
9. Zhao YY, Yuan PB, Chen L. Problems faced by advanced maternal age in the age of two children. Chin J Pract Gynecol Obstet 2020;36(2): 97 – 100. https://kns.cnki.net/KCMS/detail/detail.aspx?FileName=ZGSF202002001&DbName=CJFQ2020. (In Chinese).
10. Department of Maternal and Child Health of the National Health Commission. Analysis report on the national maternal and child health information for 2020. [2020-12-8]. (In Chinese).
11. Knight HE, Self A, Kennedy SH. Why are women dying when they reach hospital on time? a systematic review of the ‘third delay’. PLoS One 2013;8(5):e63846. http://dx.doi.org/10.1371/journal.pone.0063846.
12. Wu YT, Chen Q, Liao HZ, Wu L, Wang ZQ, Xu HL, et al. Matching degree between the classification of maternal pregnancy risk and the level of midwifery institutions, Guangdong. Mod Prev Med 2020;47(1):84 – 7. http://d.wanfangdata.com.cn/periodical/xdyfyx202001020. (In Chinese).

Preplanned Studies

Health Status of Left-Behind Children and Parenting Behaviors of Caregivers in Poor Rural Areas — 6 Provinces, China, 2018

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Summary

What is already known about this topic?

China has a significant population of left-behind children, and their health and living environments remain a major public health challenge. Children under 6 years old are especially vulnerable to poor health knowledge and behaviors of their caregivers.

What is added by this report?

The prevalence of stunting, being underweight, and often sick were 13%, 3.4%, and 5%, respectively. Only 53.9% of left-behind children could eat meat often, and 59.5% could control their intake of sugary drinks. The proportions of children who had a safe home environment, a safe play environment, and no family violence were 22.5%, 75.3%, and 45.9%, respectively. The percentages of caregivers who ensured that they rarely left their children alone and were always in their sight are 76.1% and 92.4%, respectively.

What are the implications for public health practice?

The implementation of early home visits is necessary to improve the physical health and safety of the living environment of left-behind children. Primary health workers should pay attention to improving the health knowledge and behaviors of caregivers.

China is experiencing massive population movements from rural to urban areas. In 2015, official estimates suggest there are 68.77 million left-behind children aged 0–17 years old in China, accounting for 25.4% of the entire population of children (*1*). For left-behind children under the age of 6, the family provides the primary environment for socialization, and family education and healthcare parenting at this stage will affect their future physical and mental health. Some studies showed that children benefited from the allowances their parents sent home. However, some surveys show that the health status of left-behind children is still not adequate and that family separation might have long-term psychological and societal costs. To assess the health status and family support of left-behind children aged 0–6 years old in China, a survey was conducted for left-behind children under 6 years old and their caregivers in 6 project counties of 6 provinces in 2018 based on the Rural Left-Behind Children's Health and Development Promotion Project, which was implemented in 2016–2020. The prevalence of stunting, being underweight, and often sick were 13%, 3.4%, and 5%, respectively; only 53.9% of left-behind children could eat meat often, and 59.5% could control their intake of sugary drinks. The proportions of children who had a safe home environment, a safe play environment, and no family violence were 22.5%, 75.3%, and 45.9%, respectively. The percentages of caregivers who ensured that they rarely left their children alone and were always in their sight were 76.1% and 92.4%, respectively. Overall, 77.6% were able to maintain hand hygiene in caring for children. The health status of left-behind children and the knowledge and behavior of caregivers still needs to be improved. Early home visits and comprehensive health care services may benefit left-behind children and their families.

The Chinese government conducted the Rural Left-Behind Children's Health and Development Promotion Project. The purpose of the project is to explore early home visit services and comprehensive healthcare intervention models for left-behind children and their caregivers in rural areas to provide family support and promote the health and development of left-behind children. The project was implemented in Hebei, Henan, Jiangxi, Guizhou, Sichuan, and Shanxi. One low-income county in each province was randomly sampled. Several townships from each project county were selected for investigation. The project started in 2016 and ended in 2020. This cross-sectional survey was conducted in 2018 and was the baseline survey. Ethical approval was obtained from the Peking University Institutional Review Board (No. IRB00001052-17109).

The investigator is the primary staff member in the project counties. Investigators measured the height and weight of left-behind children, and other health indicators were self-reported by the caregivers. According to the home environment risk factor screening form, the investigators observed and evaluated the home environment and recorded and evaluated parent-child interactions and parenting behaviors by questioning caregivers. A stratified analysis was conducted based on age group (<3 years and 3–6 years) and gender (male and female). The determination of stunting and being underweight were based on the World Health Organization (WHO) Child Growth Standard (*2*). SAS software (version 9.4, SAS Institute, Cary, NC, USA) was used for analysis. Cochran-Mantel-Haenszel χ^2 tests and Fisher's exact tests were used for comparison of categorical outcomes. Continuous outcomes were analyzed by using Student's *t*-test; $P<0.05$ were considered to indicate statistical significance.

Table 1 showed the sociodemographic characteristics of left-behind children and caregivers in 6 counties. Overall, 953 children were surveyed in 6 project counties, and the response rate was 100%. Due to the lack of important demographic data, the data of 21 children were withdrawn and 932 children were included in analysis (97.8%). Of these children, 500 (53.6%) were male and 432 (46.4%) were female. The average age of left-behind children was 36.84±17.95 months; 663 (72.1%) children had parents that lived separately and migrated away from the original home; and 767 (82.3%) children had caregivers that were

TABLE 1. The sociodemographic characteristics of left-behind children and caregivers in poor rural areas — 6 provinces, China, 2018.

Variables	Shanxi	Henan	Hebei	Guizhou	Sichuan	Jiangxi	Total
Gender (N, %)							
Male	134 (52.1)	81 (56.3)	45 (43.7)	127 (58.5)	29 (46)	84 (56.4)	500 (53.6)
Female	123 (47.9)	6 2(43.7)	58 (56.3)	90 (41.5)	34 (54)	65 (43.6)	432 (46.4)
Age, months (mean±SD)	33.9±17.56	44.09±16.18	39.34±18.71	38.94±16.8	29.54±24.49	33.22±15.01	36.84±17.95
Parent migration (N, %)							
Father	142 (55.9)	5 (3.6)	47 (46.5)	3 (1.4)	1 (1.7)	24 (16.3)	222 (24.20)
Mother	3 (1.2)	0 (0.0)	0 (0.0)	1 (0.5)	0 (0.0)	30 (20.4)	34 (3.7)
Both	109 (42.9)	135 (96.4)	54 (53.5)	213 (98.2)	59 (98.3)	93 (63.3)	663 (72.1)
Insured family (N, %)							
Yes	11 (4.3)	15 (10.5)	2 (1.9)	14 (6.5)	2 (3.2)	7 (4.7)	51 (5.5)
No	246 (95.7)	128 (89.5)	101 (98.1)	203 (93.5)	61 (96.8)	142 (95.3)	881 (94.5)
Height, cm (mean±SD)	92.26±15.45	96.52±18.41	91.09±16.94	93.37±13.82	57.65±48.17	69.56±42.76	87.07±27.89
Weight, kg (mean±SD)	13.47±4.0	15.99±4.14	14.42±4.18	14.35±3.84	6.78±8.45	10.68±7.22	13.27±5.56
Caregivers' age, years (mean±SD)	43.04±14.49	55.37±6.77	51.28±13.98	55.97±7.28	55.56±9.43	54.85±11.47	51.59±12.45
Caregivers' gender (N, %)							
Male	15 (5.8)	52 (36.4)	19 (18.4)	48 (22.1)	10 (15.9)	30 (20.1)	174 (18.7)
Female	242 (94.2)	91 (63.6)	84 (81.6)	169 (77.9)	53 (84.1)	119 (79.9)	758 (81.3)
Caregivers' education level (N, %)							
Illiteracy	17 (6.6)	8 (5.6)	4 (3.9)	45 (20.7)	19 (30.2)	18 (12.1)	111 (11.9)
Primary school	81 (31.5)	49 (34.3)	32 (31.1)	112 (51.6)	38 (60.3)	87 (58.4)	399 (42.8)
Junior high school	91 (35.4)	57 (39.9)	50 (48.5)	50 (23.0)	6 (9.5)	39 (26.2)	293 (31.4)
High school	28 (10.9)	28 (19.6)	15 (14.6)	10 (4.6)	0 (0.0)	4 (2.7)	85 (9.1)
College	40 (15.6)	1 (0.7)	2 (1.9)	0 (0.0)	0 (0.0)	1 (0.7)	44 (4.7)
Caregivers' relationship (N, %)							
Mother	111 (43.2)	3 (2.1)	30 (29.1)	0 (0.0)	0 (0.0)	10 (6.7)	154 (16.5)
Father	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Grandparents	145 (56.4)	140 (97.9)	72 (69.9)	210 (96.8)	63 (100.0)	137 (91.9)	767 (82.3)
Other relatives	0 (0.0)	0 (0.0)	1 (1.0)	7 (3.2)	0 (0.0)	2 (1.3)	10 (1.1)

grandparents. The average age of the caregivers was 51.59±12.45 years. Most caregivers were female (81.3%) and had not received high school education or higher (86.1%).

The prevalence of stunting, being underweight, and often sick were 13%, 3.4%, and 5%, respectively. Overall, 59 (6.3%) children were moderately stunted and 62 (6.7%) were severely stunted. No differences in stunting were identified between male and female children(*P*=0.423); however, the differences between children aged <3 years and 3–6 years old was significant. Furthermore, 21 (2.3%) children were moderately underweight and 10 (1.1%) were severely underweight. No differences were identified between <3 years and 3–6 years old for being underweight. (*P*=0.468) The differences between male and female was significant (*P*<0.001) (Table 2).

Table 3 showed the parenting behavior of caregivers in health, nutrition, and family safety. Of the 953 participants, 502 (53.9%) children could eat meat often and 555 (59.5%) could control their intake of sugary drinks. The proportions of children who had safe living environments and safe play environments were 22.5% and 75.3%; 428 (45.9%) children had not experienced family violence; the percentages of caregivers who ensured that they rarely left their children alone and were always in their sight were 76.1% and 92.4%, respectively; and 77.6% of left-behind children could maintain proper hand hygiene.

DISCUSSION

A cross sectional survey in 6 counties in China was conducted to investigate the health status of left-behind children and the knowledge and behavior of their caregivers. A total of 932 children were included in analysis. The prevalences of stunting, being underweight, and often sick were 13%, 3.4%, and 5%, respectively.

Compared with previous surveys of left-behind children in China, the growth and development of left-behind children in this study had largely better results. The prevalence of stunting and being underweight were 13% and 3.4%, respectively, which was lower than that among children aged under 5 years that the National Nutrition and Health Monitoring System reported in 2013 (19.0% and 5.1%, respectively)(*3*). The prevalence of stunting was also lower than the data from China's Food and Nutrition Monitoring in 2010 (20.3%) (*4*). The prevalence of children that were sick often was 5%, which was lower than results reported by the Fifth National Health Service Survey in 2013

TABLE 2. Prevalence of stunting and underweight across genders and age groups of left-behind children in poor rural areas — 6 provinces, China, 2018.

Item	Male	Female	*P*	<3 years	3–6 years	*P*
Stunting			0.423			<0.001
Moderate	28	31		28	31	
Severe	35	27		38	24	
Underweight			<0.001			0.468
Moderate	15	6		12	9	
Severe	2	8		5	5	

TABLE 3. Parenting behavior of caregivers of left-behind children in poor rural areas — 6 provinces, China, 2018.

Item	N	Percentage (%)
Children often washed their hands	723	77.6
Children rarely became sick	606	65.0
Children ate meat often	502	53.9
Children rarely drank sugary drinks	555	59.5
Children were not allowed to stay alone for more than an hour	709	76.1
When looking after the child, the child was always in sight	861	92.4
No family violence	428	45.9
The child did not play with animals alone	711	76.3
No risk factors in the family living environment	210	22.5

Notes: 1) N is the number of positive cases of corresponding investigation items. 2) The total number of participants is 953.

that suggested the two-week prevalence of sick often of left-behind children under 5 years was 10.5%.

Most of the parents of left-behind children migrate to urban areas to work, leaving the children to their grandparents. Most of these left-behind children were under 3 years old when their parents left. Therefore, intergenerational parenting was a common phenomenon for left-behind children, but the education level of caregivers in this study was generally low.

The 2018 census data showed that the floating population reached 241 million, accounting for 18% of the total population. In the past 35 years, economic development has driven the increase in the number of migrants and also brought opportunities for China's social development. But population migration has caused many family problems. The Fifth National Health Service Survey reported that left-behind children mainly suffered from respiratory diseases. After the illness occurred, 87% of the parents of left-behind children took their children to see a doctor and 9.4% self medicated (*5*).

Some reviews suggested that children benefited from the allowances their parents sent home through improved education and reduced child labor, which could result in improved health, but reported that family separation might have long-term psychological and societal costs (*6*). However, we found that the health and living environments of left-behind children also needed to be improved.

For children under 6 years old, the knowledge and behavior of the caregiver has an important impact on the health of the child. Most of the guardians of left-behind children were their grandparents, which was similar to the results of other studies (*7*–*8*). Although most left-behind children used various communication devices to keep in touch with their parents, they still feel lonely (*9*). The lack of grandparents' knowledge of early childhood development and physical health may adversely affect the physical, educational, and psychological development of left-behind children (*10*). Therefore, conducting early home visits might be a necessary intervention. Primary health workers can help improve the family environment and the nurturing behavior of caregivers to promote the health of left-behind children.

This study was subject to several limitations. The research sample came from underdeveloped areas in China and cannot represent other rural areas in China. Some studies compared the left-behind children with children of non-migrants and found that left-behind children had increased risk of depression and higher depression scores, anxiety suicidal ideation, conduct disorder, substance use, and wasting and stunting, but children of non-migrants were not recruited. Furthermore, the two-week prevalence and disease types of left-behind children were not collected. This may limit our understanding of the health status of left-behind children.

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REFERENCES

1. National Bureau of Statistics of China, UNICEF, UNFPA. Highlights of population status of children in China in 2015: facts and figures. 2018. https://www.unicef.cn/en/reports/highlights-population-status-children-china-2015. [2020-11-09]
2. WHO Multicentre Growth Reference Study Group, de Onis M. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr 2006;450(S450):76-85. https://pubmed.ncbi.nlm.nih.gov/16817681/.
3. Chang JL, Wang Y. National nutrition and health monitoring: general report 2010-2013. Beijing: Peking University Medical Press. 2016. (In Chinese).
4. Chen CM, He W, Wang YY, Deng LN, Jia FM. Nutritional status of children during and post-global economic crisis in China. Biomed Environ Sci 2011;24(4):321 – 8. http://dx.doi.org/10.3967/0895-3988.2011.04.001.
5. Center for Health Statistics and Information, NHFPC. An analysis report of national health services survey in China, 2013. Beijing: China Union Medical University Press. 2015. (In Chinese).
6. Fellmeth G, Rose-Clarke K, Zhao CY, Busert LK, Zheng YT, Massazza A, et al. Health impacts of parental migration on left-behind children and adolescents: a systematic review and meta-analysis. Lancet 2018;392(10164):2567 – 82. http://dx.doi.org/10.1016/S0140-6736(18)32558-3.
7. Zhang N, Bécares L, Chandola T, Callery P. Intergenerational differences in beliefs about healthy eating among carers of left-behind children in rural China: a qualitative study. Appetite 2015;95:484 – 91. http://dx.doi.org/10.1016/j.appet.2015.08.024.
8. Jia ZB, Tian WH. Loneliness of left-behind children: a cross-sectional survey in a sample of rural China. Child Care Health Dev 2010;36(6):812 – 7. http://dx.doi.org/10.1111/j.1365-2214.2010.01110.x.
9. Shen M, Gao J, Liang ZZ, Wang YJ, Du YK, Stallones L. Parental migration patterns and risk of depression and anxiety disorder among rural children aged 10-18 years in China: a cross-sectional study. BMJ Open 2015;5(12):e007802. http://dx.doi.org/10.1136/bmjopen-2015-007802.
10. Yao SY, Wang JP, Xiao SY, Jin X, Xiong M, Peng J, et al. Inadequate nutrition and associated factors in children aged 6 to 24 months — 4 counties, Liangshan Yi Autonomous Prefecture, China 2018. China CDC Wkly 2020;2(45):873 – 7. http://dx.doi.org/10.46234/ccdcw2020.155.

Perspectives

Tuberculosis in Schools and Requirements for Prevention and Control in China

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In recent years, although tuberculosis (TB) control in schools has achieved success to some extent, TB outbreaks still occur in schools from time to time. There are gaps in the response to TB outbreaks, which should be identified and addressed through a series of integrated measures that should be implemented and further strengthened. This article summarizes the circumstances of TB outbreaks in schools, their characteristics, and experiences and lessons that can be learned to improve TB prevention and control.

TUBERCULOSIS IN SCHOOLS

In 2019, there were about 274 million students on campus (accounting for 19.6% of the national population) and 76 million newly enrolled students (*1*). The prevalence of TB in schools has been declining overall but has shown a slight rise in recent years. The reported incidence of TB among students dropped from 20.64/100,000 enrolled students in 2010 to 13.39/100,000 in 2015 but increased to 17.50/100,000 in 2019. During the same period, the percentage of student TB cases in all TB cases dropped from 4.94% to 3.97% and then rose to 6.19% (*2*–*5*). More than 100 TB outbreaks in schools have been reported since 2008; the number hit a peak in 2017 and then declined year over year. TB outbreaks often occurred in boarding schools with 70% being senior high schools or technical secondary schools and about 20% being private schools.

All TB outbreak investigation reports during 2017–2019 were collected from the Emergency Public Health Events Reporting System of China CDC and were analyzed for common characteristics. Overall, 48 TB outbreaks in schools were reported from 2017 to 2019, 36 in senior high schools, 8 in colleges and universities, 2 in junior high schools, and 2 in vocational schools. More types of schools were found reporting TB outbreaks in these 3 years, being different from that before 2017. The proportion of outbreaks in senior high schools dropped from 77% in 2016 to 50% in 2019, and the TB outbreaks in vocational schools were reported. On average, 24 patients were found in each outbreak, and there were 9 outbreaks that had more than 30 patients found. There were 2 public health emergencies caused by the spread of multidrug-resistant TB (MDR-TB) in schools.

EXPERIENCE AND LESSONS FOR TB CONTROL IN SCHOOLS

Experiences and lessons were summarized from these TB outbreaks. First, the routine measurements for TB prevention and control in schools were inadequate. Students did not receive TB checks at the time of enrollment. Within the 48 schools with TB outbreaks, 16 schools failed to perform any physical examinations for newly enrolled students or excluded TB checks from physical examinations; 4 schools performed TB tests exclusively using chest X-ray or using TB antibody screening, which breached the guidelines; at least 17 schools failed to implement morning check-ups for TB symptoms or any tracing and registration for students with illness, leading to the failure of early detection of students with TB symptoms or suspected TB patients. Classrooms and dormitories in most schools were poorly ventilated; and 23 schools reported poor ventilation and no established regulation for ventilation.

Second, the diagnosis, treatment, and infectious case reporting at health facilities needed to be enhanced. The proportion of bacteriologically positive patients rose from 10% in 2017 to 23% in 2019 but remained very low. Underreporting for infectious disease cases has decreased, but there was a long interval of time between diagnosis and reporting, even longer than 2 weeks in some health facilities. These reports that did not follow professional guidelines delayed the ability for schools to promptly respond to TB cases.

Third, the outbreak response measures at lower-level CDCs have yet to be standardized. The timeliness of close contact screening has improved: the median number of days of the interval between the diagnosis of index cases and close contacts screening has dropped from 7 days to 3 days from 2017 to 2019. Detailed investigation and analysis should be conducted scientifically to determine the reasonable scope of contact screening. However, the scope of screening was often insufficient in the early stage of responses. In addition, the screening methods needed to be further standardized. In some outbreak responses, symptom screening was the only method carried out, chest fluoroscopy was performed instead of chest X-ray, or tuberculin skin test (TST) was not performed.

Finally, there was a lack of scientific understanding of TB among students and parents, and delays in seeking health care were prevalent. The average interval between the onset of symptoms and the diagnosis at the designated health facility was more than 70 days. For fear of being stigmatized against or negatively impacting their studies, some students and their parents choose to conceal the illness and continue school attendance, leading to continuous transmission in schools.

REQUIREMENTS FOR TB CONTROL IN SCHOOLS

In recent years, health departments and education departments have attached great importance to TB control in schools, striving to raise TB detection rates and reduce TB outbreaks in schools. However, there are still many shortcomings in TB control work, which should be recognized, and a series of integrated measures should be implemented and further strengthened (*6*):

First, schools should be instructed on TB control. Through work meetings and training, schools should be guided to carry out physical examinations with all newly enrolled students, and the frequency of TB screening should be elevated in some areas and schools when necessary (*7*–*8*). Morning check-ups and tracing of students with illnesses should be reinforced, and the referral and arrival rates of students with suspected symptoms and suspected patients should be raised. In addition, the environment in schools should be improved, especially for ventilation in classrooms and dormitories.

Second, all areas should establish effective channels for communication among schools, local CDCs, and health facilities within their jurisdictions to facilitate information exchange and standardize case reporting and registration. Capacities in surveillance and early warning systems should be strengthened with enhanced efficiency of data utilization. Early warning information based on individual cases should be thoroughly explored (*9*), and automated-alert methods and thresholds should be optimized to identify high-risk schools promptly (*10*).

Third, when a TB outbreak occurs, the principle of simultaneous investigation, management, and improvement should be followed to identify the cause of the outbreak and control and prevent further spread of TB. Once any TB cases are detected in a school, an investigation should be carried out as soon as possible to assess and judge the situation and the possibility of TB spread. All cases should be searched and verified case by case. The time distribution of the cases, case distribution in classes and dormitories, distribution of population characteristics, and the correlation among them should be analyzed. Close contacts should be screened for TB: symptom screening, TST, and chest X-ray should be performed simultaneously for those aged 15 and above; for those under 15 years of age, symptom screening and TST should be performed first, and chest X-ray should then be performed for those being found with suspected symptoms or strong positive TST. According to the situation on the spot and the findings of screening, the scope of screening should be expanded as appropriate. In general, screening should first be performed with teachers and students who were in the same class or dormitory as the patient. If a new TB case is found, screening must be extended to students and teachers on the same teaching building floor and dormitory floor as the case. In addition, it should be noted that family members in close contact with TB cases should also be screened. All active TB cases should be incorporated into the scope of TB control programs for case management and standardized treatment. Those who meet the criteria for suspension of schooling must suspend their schooling for medical treatment. Suspected cases should be isolated from other students before a final diagnosis is made. On the basis of excluding TB and related contraindications, it was recommended that students with strong positive TST alone receive preventive treatment intervention with their informed consent.

Finally, TB health education in schools should be improved in a variety of ways. The awareness of TB identification and prevention among students and their parents should be enhanced. Sound healthcare practices and moral literacy should be developed, including prompt health-seeking upon illness, disclosure of disease diagnosis without concealment, and voluntary suspension of school attendance when necessary.

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REFERENCES

1. National Bureau of Statistics of the People's Republic of China. China statistical yearbook. Beijing: China Statistics Press. 2020. http://www.stats.gov.cn/tjsj/ndsj/2020/indexch.htm. (In Chinese).
2. Du X, Chen W, Huang F, Wang W, Yan FX, Wang HF, et al. Characteristics analysis of national student reported incidence of tuberculosis, 2004–2008. Chin J Health Educ 2009;25(11):803 – 6, 810. http://d.wanfangdata.com.cn/periodical/ChlQZXJpb2RpY2FsQ0hJTmV3UzIwMjAxMjI4Eg96Z2prankyMDA5MTEwMDEaCDl2d2FmMmg1. (In Chinese).
3. Xia YY, Ma Y, Chen W, Cheng SM. Epidemic features of pulmonary tuberculosis in students in China: data mining based on national disease surveillance system. Chin J Antituberculosis 2013;35(11): 871 – 5. http://d.wanfangdata.com.cn/periodical/zgflzz201311005. (In Chinese).
4. Chen W, Chen QL, Xia YY, Cheng SM. Analysis of the characteristics of national TB epidemic situation in schools from 2008 to 2012. Chin J Antituberculosis 2013;35(12):948 – 54. http://d.wanfangdata.com.cn/periodical/zgflzz201312001. (In Chinese).
5. Chen H, Xia YY, Zhang CY, Cheng J, Zhang H. Epidemic trends and characteristics of pulmonary tuberculosis in students in China from 2014 to 2018. Chin J Antituberculosis 2019;41(6):662 – 8. http://dx.doi.org/10.3969/j.issn.1000-6621.2019.06.01. (In Chinese).
6. National Health and Family Planning Commission of the People's Republic of China, Ministry of Education of the People's Republic of China. National norm of tuberculosis prevention and control in school (2017). 2017. http://www.moe.gov.cn/srcsite/A17/moe_943/s3285/201707/t20170727_310182.html. (In Chinese).
7. Pang Y, Wu CG, Liu Y, Zhang T, Duan WX, Yu Y, et al. Disposal measures of school tuberculosis outbreak in Chongqing. China Trop Med 2019;19(1):97 – 9. http://dx.doi.org/10.13604/j.cnki.46-1064/r.2019.01.25. (In Chinese).
8. Xiao X, Chen J, Li XQ, Xia Z, Luan RR, Rao LX, et al. Analysis of the epidemiological characteristics of tuberculosis students in Shanghai from 2009 to 2017. Chin J Antituberculosis 2020;42(5):498 – 502. http://dx.doi.org/10.3969/j.issn.1000-6621.2020.05.015. (In Chinese).
9. Chen YZ, Tan SY. Research progress of strategy on tuberculosis aggregation epidemic monitoring and early warning in school. J Tuber Lung Health 2015;4(1):57 – 60. http://dx.doi.org/10.3969/j.issn.2095-3755.2015.01.013. (In Chinese).
10. Cheng J, Liu JJ. Current status and progress of surveillance and automated-alert for tuberculosis in school. Chin J Antituberculosis 2020;42(5):436 – 41. http://dx.doi.org/10.3969/j.issn.1000-6621.2020.05.005. (In Chinese).

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