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Analysis on delay in seeking medical treatment and influencing factors among students with tuberculosis in Wuhan,China during 2012–2023

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Abstract

Delay in seeking medical treatment is a significant factor hindering the target process of ending tuberculosis, worsening patient health and increasing transmission risk. We evaluated delay in seeking medical treatment among PTB students in Wuhan registered in NTBIMS during 2012-2023. Among 4,517 pulmonary TB student patients, 61.81%(2,792/4,517) were males, with a median age of 19 (IQR, 17,21) years. The median time for students to seek medical treatment was 11 days (IQR, 5,21) and 38.54% (1,741/4,517) students waited over 14 days after symptom onset. Delay trends in seeking medical treatment among students remained relatively stable except during the COVID-19 pandemic. Bivariable logistic analysis showed higher delay risks among students who were aged 6□11, Non-Han Chinese, from far urban areas, tracking patient source and sputum bacteria positive or tuberculous pleurisy patients. Non-Han Chinese patients (RR = 2.009),track source patients (RR = 1.916) and sputum bacteria positive patients (RR = 1.193)were key influencing factors. Delay in seeking medical treatment among students is still common in China.Enhanced health education, daily symptom screening, and case diagnosis verification and tracking is crucial for mitigating delay in seeking medical treatment, Future research should focus on a collaborative School–Family–Disease Control center approach, and evaluating the effectiveness of tailored interventions to improve T'B control strategies for schools.

Introduction

Pulmonary tuberculosis(PTB) is a chronic infectious disease caused by mycobacterium tuberculosis[1].The stage from the appearance of mild symptoms in the body to seeking treatment in the formal health care facility is when tuberculosis is prone to spread,especially in densely populated areas[2].Timely detection and cure of tuberculosis is an effective means to control tuberculosis, school is a special place with a dense population,where frequent contact among students,Once students who suffer from tuberculosis, if they are not detected and isolated in time, which may increase the chance of transmission and even cause some negative social impact[3–4].

Wuhan is located in the central part of China, the tuberculosis epidemic is at a medium level in China[5], with a permanent resident population of 13 million, including more than 2.3 million students. There are thousands of schools. nearly 1.2 million college students from all over the world are admitted to Wuhan for education every year. whereas the uneven awareness of tuberculosis prevention and control in schools, and the varying levels of TB infection among students from different sources, tuberculosis outbreaks occur from time to time[6–7]. we have found delay in seeking medical treatment among sick students was one of the important factors for the spread of tuberculosis in the school tuberculosis epidemic investigation and response. Although there are many studies on delay in seeking medical treatment among PTB patients in China and abroad[8–9], there are few studies on the student population, especially in the event of a serious infectious disease outbreak such as COVID-19. This study aims to provide direction and data support for school tuberculosis prevention and control by analyzing the characteristics and influencing factors of delay in seeking medical treatment among students in the central China, so as to take targeted prevention and control strategies to quickly reduce the incidence rate of tuberculosis in schools, especially the outbreak of tuberculosis.

Methods

Data collection

This study was approved by the Ethics Committee of Wuhan Pulmonary Hospital (Approval No.: 2022058). Given the retrospective nature of the analysis using anonymized data, the ethics committee waived the requirement for informed consent. The surveillance data for TB in Chinese mainland from 2014 to 2023 were obtained from the National Tuberculosis Information Management System (NTBIMS), which is an internet-based real-time disease-reporting system. The reported cases encompass suspected case, clinically diagnosed cases and etiologically confirmed cases, which was diagnosed according to the diagnostic criteria for tuberculosis stipulated and issued by the National Health Commission of the People's Republic of China(NHC). Suspected cases were not included in the analysis after diagnosis and exclusion, focusing on clinically diagnosed and etiologically confirmed cases. The data in the analysis included demographic details (name, gender, age ,nation occupation and patient derived source) and clinical diagnosis and treatment details (symptom onset date, diagnosis date and diagnosis category).

Related definition

Pulmonary tuberculosis patients diagnosis

Patients with two or more positive sputum smears, sputum cultures, or gene x-pert positive for nucleic acid tests are diagnosed as pathogen positive pulmonary tuberculosis.The patients are diagnosed as pathogen negative with whose sputum is found to be pathogen negative through laboratory and molecular biology testing,but chest imaging shows lesions consistent with active pulmonary tuberculosis and the tuberculin tests are strongly positive or the interferon gamma release tests are positive [10].

Student

Students refer to who diagnosed as PTB in the designated hospitals of tuberculosis in the mainland, and the occupation is student, including preschool students, primary school students, junior high school students, senior high school students, university students and graduate students (master students and doctoral students) in kindergartens, primary schools, junior high schools, high school students, university students and graduate students

Days for seeking medical treatment

The time interval between the onset of major symptom appearance date and the first visit to the formal health care facility.

Treatment seeking delay

Treatment seeking delay is defined as the time interval between the onset of the major symptoms of tuberculosis (TB) and the first visit to the formal health care facility≥14 days[11].

Statistical analysis

Data entered into the Statistical Package for Social Science (SPSS) version 25. Data were cleaned, categorized and analyzed.and tables were used to present these data .The central and discrete trends of the student's first visit days data were described using mean ± standard deviation, median, and upper and lower quartiles (P_{25}, P_{75}), respectively, while the student first visit delay proportion data was described using frequency (n) and percentage (%). The time and delay proportion of students were compared by Wilcoxon rank sum test , Chi square test or Fisher's exact probability method, respectively. Bivariable and multivariable logistic regression analysis were used to show relationship between variables. Independent variables with a $P<0.05$ in the bi-variable entered in to multivariable logistic regression model, adjusted odds ratio (AOR) and corresponding 95% confidence intervals were retrieved. Those variables with $P<0.05$ were considered as statistically significant differences.

Results

Socio demographic characteristics of student patients

4,517 students with PTB were included in this study, aging from 3 to 45years old, with an average age of (19.03 ± 0.05) years and a median age of 19 (IQR, 17,21) years, of which 62.30% and 37.70% were from 2012 to 2017 and 2018 to 2023, respectively. students from the near urban area and far urban area accounted for 73.72% and 26.28% ,respectively.Males and females accounted for 61.81% and 38.19% ,respectively, with the highest proportion of students aged 18–22, accounting for 48.30%. 98.63% of the students are Han Chinese.The main source of students with PTB was referral (76.55%), followed by track (19.13%) and direct medical consultation (3.52%). 99.54% of students with PTB were new patients according to registration classification.63.78% of the sputum samples of patients were negative for TB bacteria, while 34.34% of patients were positive for TB bacteria, and 1.88% of tuberculosis pleurisy by the diagnostic classification.

Time of seeking medical treatment among student patients

The average time for PTB students to seek medical treatment in Wuhan was (19.23 ± 0.42) days, with a median of 11 days(IQR, 5,21). Non-Han Chinese student patients had significantly longer time of seeking medical treatment than those from the Han Chinese group($Z=-2.133$, $P = 0.033$),the student patients from track or proactive screening sources had obvious longer time than that of other source groups($Z=-11.655$, $P = 0.020$). The differences in seeking medical treatment time analyzed by factors such as year, gender, age, place of residence, patient registration classification, diagnostic classification and therapeutic classification were not statistically significant ($P > 0.05$, Table 1).

Table 1
The time and proportion of delay in seeking medical treatment among student patients in Wuhan,China during 2012-2023

variable	Number of student patients	Days between symptom onset and seeking medical treatment	Z /H value	*P*	Number of student patients seeking medical treatment delay	Proportion of seeking medical treatment delay	*c2*	*p*
	N (%)	$M_d(P_{25}, P_{75})$			N	(%)		
Year			-1.305	0.192			0.008	0.930
2012–2017	2814 (62.30)	10.00 (5.00, 21.00)			1086	38.59		
2018–2023	1703 (37.70)	11.00 (5.00, 21.00)			655	38.46		
Gender			-0.262	0.794			0.033	0.857
male	2792 (61.81)	11.00 (5.00, 21.00)			1079	38.65		
Female	1725 (38.19)	11.00 (5.00, 22.00)			662	38.38		
Age			5.098	0.165			11.609	**0.009**
≤ 5	15 (0.003)	8.00 (4.50, 19.00)			5	33.33		
6–11	93 (0.021)	16.00 (9.00, 35.00)			51	54.84		
12–17	1230 (0.272)	10.00 (4.25, 21.00)			457	37.15		
≥ 18	3179 (0.704)	11.00 (5.00, 21.00)			1228	38.63		
Nation			-2.133	**0.033**			7.047	**0.008**
Han Chinese	4455 (98.63)	11.00 (5.00, 21.00)			1707	38.32		

variable	Number of student patients	Days between symptom onset and seeking medical treatment	Z /H value	*P*	Number of student patients seeking medical treatment delay	Proportion of seeking medical treatment delay	*c2*	*p*
	N (%)	$M_d(P_{25}, P_{75})$			N	(%)		
Non-Han Chinese	62 (1.37)	15.00 (9.00, 23.00)			34	54.84		
Place of residence			-0.155	0.877			71.048	**<0.001**
Near urban area	3330 (73.72)	11.00 (5.00, 21.00)			1162	34.89		
Far urban area	1187 (26.28)	11.00 (5.00, 22.00)			579	48.78		
Patient registration classification			2.591	0.274			3.633[a]	0.159
New patient	4496 (99.54)	11.00 (5.00, 21.00)			1730	38.48		
Recurrence	16 (0.35)	8.00 (3.75, 33.50)			7	43.75		
Initial treatment failure or other situations	5 (0.11)	21.00 (17.00, 29.00)			4	80.00		
Patient source			11.655	**0.020**			39.572	**<0.001**
Direct medical consultation	159 (3.52)	9.00 (7.00, 18.00)			52	32.70		
Referral	3458 (76.55)	10.00 (5.00, 20.00)			1262	36.50		
Track	864 (19.13)	13.00 (5.00, 31.00)			412	47.69		

variable	Number of student patients	Days between symptom onset and seeking medical treatment	Z /H value	*P*	Number of student patients seeking medical treatment delay	Proportion of seeking medical treatment delay	*c2*	*p*
	N (%)	$M_d(P_{25}, P_{75})$			N	(%)		
Physical examination	12 (0.27)	10.50 (4.50, 18.00)			4	33.33		
Proactive screening	24 (0.53)	13.00 (8.25, 23.00)			11	45.83		
Diagnostic classification			1.029	0.598			6.293	**0.043**
Sputum bacteria Positive	1551 (34.34)	11.00 (5.00, 23.00)			635	40.94		
Sputum bacteria negative	2881 (63.78)	10.00 (5.00, 21.00)			1071	37.17		
Tuberculous pleurisy	85 (1.88)	13.00 (8.00, 23.00)			35	41.18		
Therapeutic classification			-1.502	0.133			1.705	0.192
Initial treatment failure or other situations	4496 (99.54)	11.00 (5.00, 21.00)			1730	38.48		
Retreatmen	21 (0.46)	17.00 (5.00, 31.00)			11	52.38		
Total	4517 (100.00)	11.00 (5.00, 21.00)			1741			

Proportion of delay in seeking medical treatment among student patients

The proportion of PTB students who experienced seeking medical treatment time delay ≥ 14 days in central China was 38.54% (1,741 /4,517), and 16.14% (729 /4,517) had seeking medical treatment time ≥ 30 days.The delay proportion of seeking medical treatment time from 2018 to 2023 (38.46%) had slightly

decreased compared to 2014 to 2017 (38.59%). The delay proportion of seeking medical treatment in far urban areas (48.78%) was significantly higher than that in nearby urban areas (34.89%). The delay proportion of seeking medical treatment in aged 6–11group (54.84%) was significantly higher than the other groups($\chi 2 = 11.609$, $P = 0.009$). Non-Han Chinese student patients had higher delay proportion than those from the Han Chinese group($\chi 2 = 7.047$, $P = 0.008$).According to patient registration classification, there were no differences in the delay proportion of seeking medical treatment among the three groups($P = 0.159$).The delay proportion of student patients from track (47.64%), proactive screening (45.83%), and referral (36.50%) patient source were relatively high and the differences among patient source were statistically significant ($\chi 2 = 39.572$,$P < 0.001$). The differences in the delay proportion of seeking medical treatment based on year, gender, patient classification and therapeutic classification were not statistically significant ($P > 0.05$) (Table 1).

Time distribution on the proportion of delay in seeking medical treatment among student patients

The proportion of delay in seeking medical treatment among student patients ≥ 14 days had fluctuated slightly from 2012 to 2019, but the changes were not significant, However, in 2020 and 2021, the proportion of delay in seeking medical treatment had decreased sharply, from 35.97% in 2019 to 26.09% in 2021,the downward trend was obvious, and then quickly climbed to 50.86% in 2022 and 47.62% in 2023. And the proportion of delay in seeking medical treatment among female student patients even had reached nearly 50%, which was significantly higher than the proportion in the previous decade. while the proportion of delay in seeking medical treatment among male student patients had not change significantly(Fig. 1).

Age distribution on proportion of delay in seeking medical treatment among student patients

Because the number of registered PTB cases among students aged 3-5 group was small, the trend fluctuated too much over time, and the trend was not representative enough, so this age group was combined with the 6–11 age group for analysis. The analysis results showed that the proportion of student patients seeking medical treatment delay in aged 3–11 group was nearly 50%, which was higher than that aged 12–17 group and over 18 years old group, and had decreased during the control period of the COVID–19, The trend of changes in the aged 12–17 and ≥ 18 group was similar, but in 2023, the proportion of student patients seeking medical treatment delay in the aged 3–11 and ≥ 18 group was increasing, while the aged 12–17 group was decreasing(Fig. 2).

Influencing factors of delay in seeking medical treatment among student patients

We conducted a multi factor logistic regression analysis with the dependent variable being whether the time of medical visits for student tuberculosis patients was ≥ 14 days (< 14 days = 0, ≥ 14 days = 1), and the independent variables being regional gender, age, ethnicity, and patient source.The analysis results showed that Non-Han Chinese were more prone to delayed medical treatment for student patients than Han Chinese (OR = 2.009, 95% CI: 1.207 ~ 3.344, $P < 0.001$), Patients from the tracking group were more inclined to the delayed medical treatment than other source groups (OR = 1.196, 95% CI: (1.334 ~ 2.752, $P < 0.001$). There

was no statistically significant difference (P > 0.05) in the impact of other factors such as age and diagnostic classification on the proportion of delay in seeking medical treatment(Table 2).

Table 2
Influencing factors of delay in seeking medical treatment among student patients in Wuhan,China

Independent variable and constant	β Value	Standard deviation	Wald χ^2	P Value	OR (95%*CI*)
Age					
3～5					1.000
6～11	0.746	0.591	1.594	0.207	2.109(0.662-6.719)
12～17	0.138	0.555	0.062	0.804	1.148 (0.386-3.410)
≥ 18	0.284	0.553	0.264	0.607	1.329 (0.449-3.930)
Nation					0.155(0.076-0.318)
Han Chinese					1.000
Non-Han Chinese	0.698	0.260	7.198	0.007	2.009(1.207-3.344)
Patient source					
Direct medical consultation					1.000
Referral	0.289	0.176	2.704	0.100	1.336(0.946-1.886)
Track	0.650	0.185	12.403	0.000	1.916(1.334-2.752)
Physical examination	0.116	0.644	0.032	0.857	1.123(0.318-3.967)
Proactive screening	0.412	0.45	0.836	0.360	1.509(0.625-3.648)
Diagnostic classification					
Sputum bacteria negative					1.000
Sputum bacteria Positive	0.176	0.066	7.167	0.007	1.193(1.048-1.357)
Tuberculous pleurisy	0.110	0.228	0.231	0.631	1.116(0.713-1.746)
constant	-1.294	0.580	4.979	0.026	0.274

Discussion

Timely detection, strict isolation and standardized treatment of PTB students are important strategies and measures to control the spread of tuberculosis in schools .This study provided insights on the proportion of delay in seeking medical treatment among PTB students and pointed out possible risk factors associated with PTB student treatment delay in Central China.In this study, we found that median time of seeking medical treatment among PTB students was 11 (IQR,5,21) days, which was shorter than most countries, such as in Ethiopia it was 35 days [12], in India 16 days [13],in Portugal 37 days[14]and in Myanmar 21 days [15]. The possible reasns for the discrepancies was that the difference in race, culture, socio-economy, medical resources, medical security policy and education[16]. Factors like lack of knowledge, worry about discrimination and school suspension ,poor accessibility of medical services, patients tend to self medicate before seeking formal medical treatment, use of dispensary and private health facilities, body mass index (BMI) status were also reported as risk factors of patient related PTB patients treatment delay in other settings. The proportion of PTB students who had ≥ 14 days of seeking medical treatment time was 38.54% (1,741/4,517), slightly higher than the median time of the whole population in Wuhan from 2008 to 2017 of 10 (IQR,3,28) days[17], and the

proportion of delay in seeking medical treatment was slightly lower than that in rural areas of Hubei Province (39.70%).the trend of fluctuation was relatively small, but the changes were significant in 2020 and 2021, This might be due to the impact of the COVID-19 outbreak in 2020 and 2021, when Chinese residents received symptoms and pharyngeal nucleic acid tests every day, and when people with cough, fever and positive nucleic acid tests were found, they were sent to the local designated isolation points and COVID□19 designated hospitals for chest radiographs. The control measures at that time might greatly promote the timely diagnosis and treatment of symptomatic TB patients.By 2023, considering that the pathogenicity of COVID□19 virus was generally weakened and the urgent need to resume economic production, the Chinese government decided to fully liberalize the control of COVID□19. Residents had new knowledge and understanding of respiratory infectious diseases.the COVID-19 epidemic had also affected economic development and residents' income, common people had respiratory symptoms and might start to buy medicine at pharmacies. Such behavior might also lead to a certain delay in the time for treatment of tuberculosis patients,this phenomenon of delay in seeking medical treatment had also been found in many other countries [18–20].Age distribution on the proportion of delay in seeking medical treatment among student patients showed that the proportion of students aged 3–11 was slightly higher than that of the other two groups. There were two possible reasons: first, because Chinese children were generally vaccinated with BCG when they were born, the incidence rate of TB among students aged 3–11 was low, which might reduce the alertness of parents to the harm of tuberculosis,they tended to engage in self-experience medication before seeking medical treatment[8,21]. Second, most children might be too young to express the suspicious symptoms of tuberculosis accurately and clearly.They were only discovered when they showed obvious symptoms, such as coughing, fever, chest tightness, or when their mental state was poor[22–23].

The multi factor analysis on the delay in seeking medical treatment in this study showed that Non-Han Chinese students are more likely to delay seeking medical treatment than Han Chinese among student patients (OR = 2.009, 95% CI: 1.207 ~ 3.344, P < 0.001),The track patient source group were more inclined to

delay medical treatment than other source groups (OR = 1.916, 95% CI: (1.334 ~ 2.752, P < 0.001). The awareness rate of ethnic minorities on tuberculosis prevention and control was generally weak. After experiencing symptoms of the disease, the willingness to seek medical attention was not very strong.which maybe related to some of their religious beliefs.while most foreign student might have language communication difficulties in Chinese hospitals, and they were worried about suspending school after being diagnosed with tuberculosis, which might cause them to be sent back for isolation and treatment, or even lost the opportunity to study in China, This may lead to students shopping in pharmacies or online to buy drugs, delaying the timely detection and standardized treatment of student cases.The proportion of delay in seeking medical treatment among students with positive sputum bacteria was significantly higher than that of students with negative sputum bacteria, which might be related to the failure to seek medical treatment timely.The proliferation of tuberculosis bacteria in the body led to an increase in the detection rate of positive sputum bacteria in patients.This study showed that the awareness of timely seeking medical treatment among students in Wuhan was not optimistic. In recent years, the proportion of delay in seeking medical treatment among students had increased.which might be one of the important factors for the many clustered outbreaks in schools,As the delayed time of seeking medical treatment would lead to the delayed time of case detection among students, which might lead to the increase of TB infection and PTB incidence of students, and the spread of tuberculosis epidemic in schools.So the following specific recommendations are proposed:(1) The school should carry out tuberculosis prevention and control work in a planned way every year, especially for minority students and foreign students, actively recruit science popularization volunteers on campus with the help of the national volunteer service network, widely publicize the common symptoms of tuberculosis and the free treatment policy, and guide symptomatic students to seek early medical treatment. (2) The school should equip doctors with medical licenses according to relevant regulations, organize regular training and study of doctors, improve the ability to diagnose PTB, optimize the medical treatment or reimbursement process of students, and find sick teachers and students as soon as possible. (3) The school selects institutions with physical examination qualifications to carry out health examination which includes tuberculin test and chest X-ray examination for new students, and timely transfer teachers and students suspected PTB to the designated hospitals (4) The school strictly implements the system of morning check ups, absenteeism due to illness, and cause tracking in daily life. The school doctor regularly summarizes relevant information and promptly reports suspected PTB cases to the local disease control center of the school. (5) The Center for Disease Control and Prevention should promptly track and verify the diagnosis of teachers and students who report warnings to medical institutions, especially those who are suspected of not being referred by the comprehensive hospitals. Once a confirmed tuberculosis patient is found, it is necessary to screen teachers and students involved in the epidemic timely ,and PTB students and LTBI should be detected from close contacts as soon as possible[24]. Diagnosed PTB should be isolated and treated, and LTBI should be given TPT. (6) The education and health administrative departments should regularly jointly carry out supervision and inspection on the daily work of school tuberculosis prevention and control, report and punish the inspection results, and urge the school and the CDC to make rectification.

Strengths and limitations of the study

In this study, We have collected data from the tuberculosis information management system for 12 years. Wuhan has a large number of students and a high incidence of tuberculosis, so we have enough case data

information to objectively analyze the time of medical treatment for students with tuberculosis.Our study also has some limitations.First, Our study does not investigate the accessibility of regional medical resources, medical preferential policies, burden of disease diagnosis and treatment costs, family religious beliefs, awareness of tuberculosis prevention and control among students and parents, family economic income, medical insurance coverage, etc.Second, The student tuberculosis cases do not include students whose registered in other cities but study in Wuhan, which may have affected the actual delay in seeking medical treatment.Third, there may be information bias in the study, some results of our data analysis are based on the daily tuberculosis prevention and control work and the changes in the current situation of the, without the support of special survey data of a large sample.

Data availability

The dataset used and analyzed in this study are available from the corresponding authors at a reasonable request.

Conclusions

The study showed that the incidence of delay in seeking medical treatment among PTB student patients in Wuhan was high, with nearly a quarter of student patients experiencing medical treatment delay. Minority student patients, traced patient source groups, and sputum positive student patients are the main groups with delayed medical treatment. It is imperative to strengthen health education for students and parents, schools' strict screening of suspected tuberculosis symptoms,as well as the CDC's timely tracking of tuberculosis patients using intelligent information technology, and take the trinity comprehensive prevention and control measures of School–Family–Disease Control center to mitigate delay in seeking medical treatment.

Abbreviations

MTB Mycobacterium Tuberculosis

PTB Pulmonary Tuberculosis

NHC National Health Commission of the People's Republic of China

NTBIMS National Tuberculosis Information Management System

LTBI Latent Tuberculosis Infection

TPT Tuberculosis Preventive Therapy

IQR Interquartile Range

OR Odds Ratio

Declarations

Clinical trial number: not applicable

Author contributions

Z.B.Z.,G.W., C.Q., Z.Q.L and J.C. designed the study and had full access to all of the data in the study and take responsibility for the integrity of the data .W.Z., and A.P.Y.collected the data. T.T.W,and J.X.W.analyzed and interpreted the data. Z.B.Z., and J.H.wrote the first draft. and J.J.W. revised the manuscript.Z.B.Z., and Y.H.L. acquired funding.

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Consent for publication

Not applicable

Competing interests

The authors declare no competing interests.

Ethics declarations

This study was approved by the Ethics Committee of Wuhan Pulmonary Hospital (Approval No.: 2022058). Given the retrospective nature of the analysis using anonymized data, the ethics committee waived the requirement for informed consent.

Additional information

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Figures

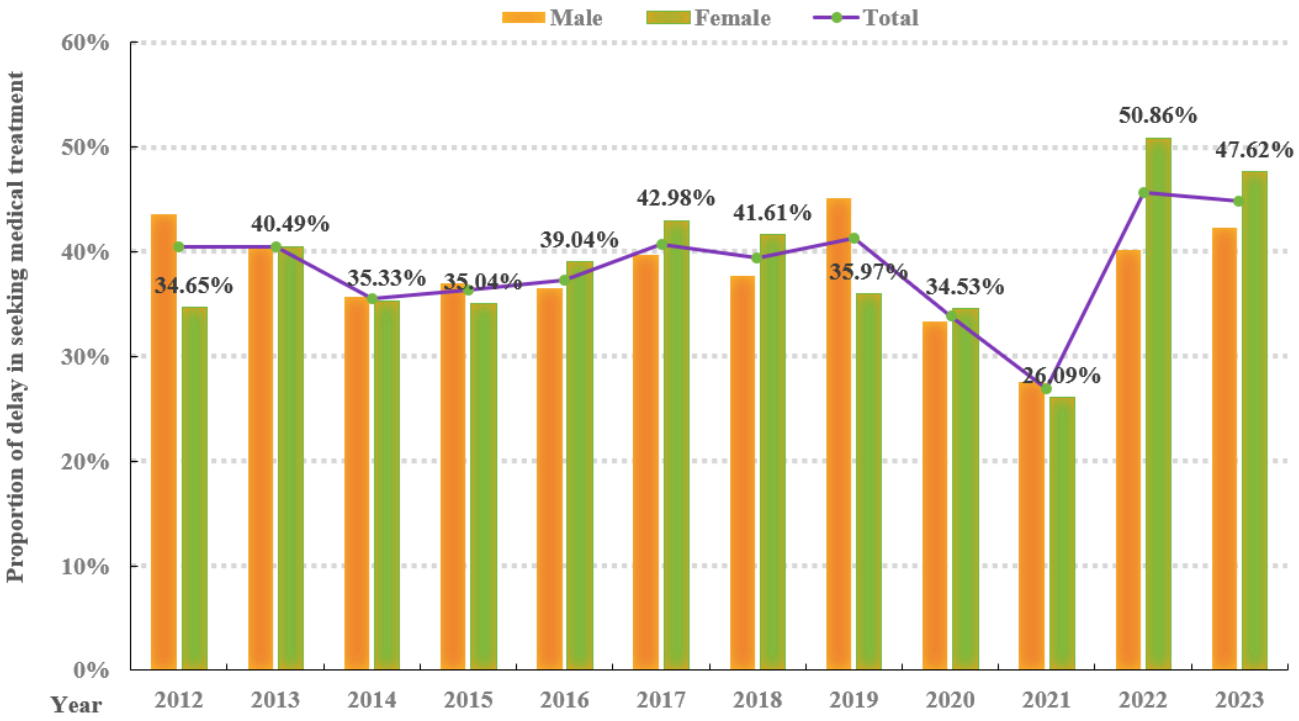


Figure 1

Time distribution on the proportion of delay in seeking medical treatment among student patients during 2012–2023 in Wuhan,China

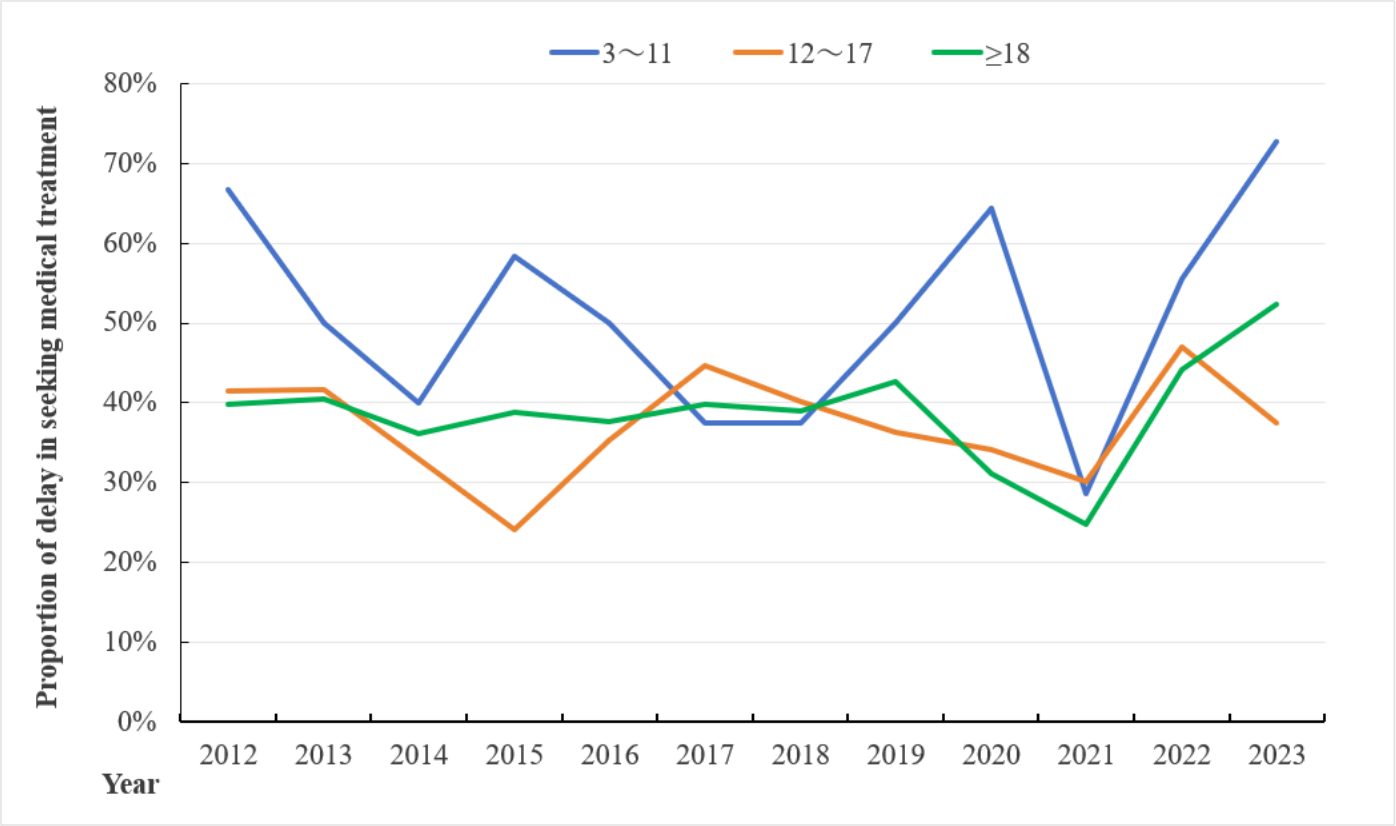


Figure 2

Age distribution on the proportion of delay in seeking medical treatment among student patients during 2012 2023 in Wuhan,Chin

Supplementary Files

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- tablecharts.xlsx
- Dataandchartslast.xlsx