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Determining the perceived safety and security attitude and knowledge of urban residents towards bus fires

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ABSTRACT

In recent years, the frequent occurrence of bus fire accidents has caused public concern in China, impacting the safe operation of urban transportation seriously. A cross-sectional survey was conducted to evaluate the safety & security (S&S) level of attitude and knowledge in relation to bus fires among residents in Fuzhou city, Fujian Province. 200 passengers from 6 bus terminals and 10 bus stations were selected as study subject. The results show that the S&S attitude and knowledge differ by gender, age, education background, occupation, and the frequency of taking a bus. The educational level significantly influences the S&S attitude and knowledge of the respondents, showing a positive correlation. Similarly, the passengers who take a bus frequently are more likely to display higher S&S attitude and knowledge scores. The participants working in governments and serving as managers in companies scored higher in attitude than the staff and students. A minority of respondents are concerned with bus fire S&S in their daily lives. Many passengers pay not much attention to the safety instructions when taking a bus. Some suggestions are given to improve S&S situation of bus transportation. The research results can lay the foundation for local governments, bus transport operators, and relevant safety organizations to establish a series of safety policies or regulations with respect to bus fires.

1. Introduction

With the urbanization speeding up in China, the urban population grows quickly and corresponding urban areas have been expanding. Therefore, public transportation by motor vehicles plays an important role in urban residents' daily life. According to the data from China National Bureau of Statistics (Fig.1), the number of bus operations in Chinese cities shows an increasing upward trend from 2008 to 2017. There were 367,292 nationwide bus operations in 2008, and the number rose up to 554,820 in 2017. Meanwhile, bus passenger

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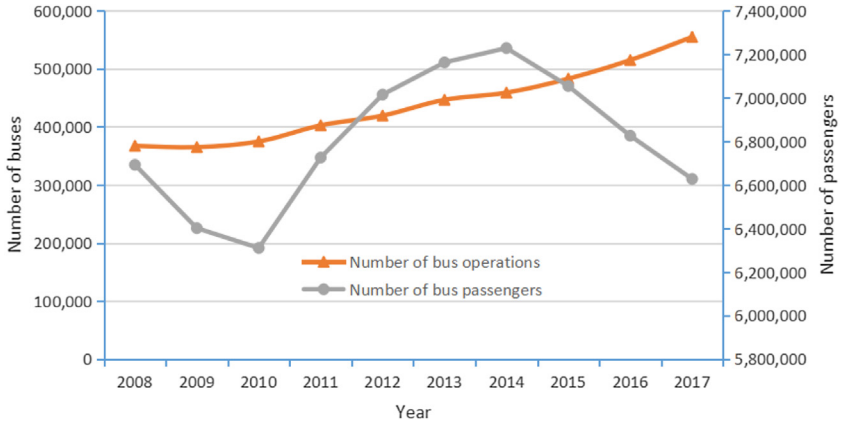

Fig. 1 – Number of bus operations and passengers in China from 2008 to 2017 [39].

flows fluctuated during this period. From 2008 to 2010, the number of bus passengers was in a slow decline. Then, an increase phenomenon appeared in the period 2010 to 2014. Since 2014, the passenger number has been decreasing again. This latter deviation may be attributed to the rise of subway transportation and the steep increase of the number of private cars, making the residents having multiple choices in their movements. Notwithstanding, the bus has always been regarded as the main public motor vehicle tool for people in small and medium-sized cities in China. As shown in Fig.2, the total length of buses running in Chinese cities maintains a stable growth from 146,514 km in 2008 to 791,365 km in 2017, with a huge increase appearing in 2010 due to the new development of China's urban construction.

At the same time, the situation of traffic accidents is also a serious and ongoing problem in China. Particularly in the past decade, the frequent occurrence of bus fires brought important losses to people's lives and disturbed the social development severely. By utilizing the Baidu search engine and the Chinese National Knowledge Infrastructure (CNKI) database, some well-known bus fire cases which took place in China from 2008 to 2018 were summarized in Table 1. It can clearly be seen that the causes of bus fires mostly refer to arson, spontaneous combustion, and passengers carrying flammable items. Most of the accidents occurred in East China with a large population and a developed economy. There were 8 cases of arson during rush hours, which caused heavy casualties. For example, on 5 May 2008, a bus fire happened on Huangxing Road in Shanghai City at 9:00 AM. Due to the inflammable substances and explosives carried by passengers, a large amount of toxic gases and heat were released on bus in a short time, resulting in 3 death and 12 injuries. On 7 June 2013, a BRT[1] bus on an elevated road caught fire near the Jinshan bus stop in the city of Xiamen in southeast China's Fujian Province at about 6:20 PM. It was reported that the bus fire was caused by a serious attack, killing 47 (including 8 students) and injuring 34 people [10], see also Fig. 3.

Bus fires are rather common events and several buses are involved in fire incidents every day worldwide [1]. Correspondingly, extensive literature on traffic safety have been published [2–7]. In China, research on bus fires started in 1987, in which some scholars attempted to uncover the reasons for bus fires. Up to 1994, bus fires have been studied by a large number of researchers in universities and institutions. For example, the first "fireproof bus" began to run in Chengdu. The Fusion Digital Simulation (FDS) method was used to simulate a bus fire in the University of Science and Technology of China [8]. In order to promote some prevention measures and emergency programs targeting bus fires, Liu et al. [9] analyzed the epidemiology of such incidents in mainland China over the past 10 years. Hu et al. [10] conducted a descriptive study recording the prehospital response and inhospital treatment of the Hangzhou bus attack on 5 July 2014, and gave some advice for handling similar events. Cheng et al. [11] introduced the application of several fire extinguishers in bus engine equipment, including ultrafine powder, water mist, and aerosol technology. Kang et al. [12] disclosed the spreading process of bus fires and analyzed the effects of ventilation conditions on the combustion behavior and person evacuation. Huang et al. [13] investigated the fire load density of bus garages and judged their fire hazard levels. However, it can be found that previous literature mainly focuses on bus fires from the technical point of view, including fire characteristics, fire emergency, fire extinguishing, and fire simulation. Few papers refer to the passengers' safety and security (S&S) attitude and knowledge towards bus fires. Therefore, it is of great significance to conduct an investigation on bus fires from passengers' viewpoints. In fact, the causes of bus fires can be attributed to some humans' unsafe-insecure behaviors (driver, passenger), or abnormal activity (arson) that deviates from ethics, and bad conditions of certain objects [14], such as mechanical parts, facilities and electrical circuits. For this reason, some scientific and technological measures can be taken into consideration to ensure the bus under a safe state. The unsafe-insecure behaviors are closely related to people's S&S attitude and knowledge, which involve drivers' wrong operations and the passengers' dangerous actions on the bus (Wang, et al, 2018). In many cases, passengers' own deaths and the endangerment of others can be attributed to lack of correct S&S knowledge and passive attitudes on emergencies [15].

[1] Bus Rapid Transit.

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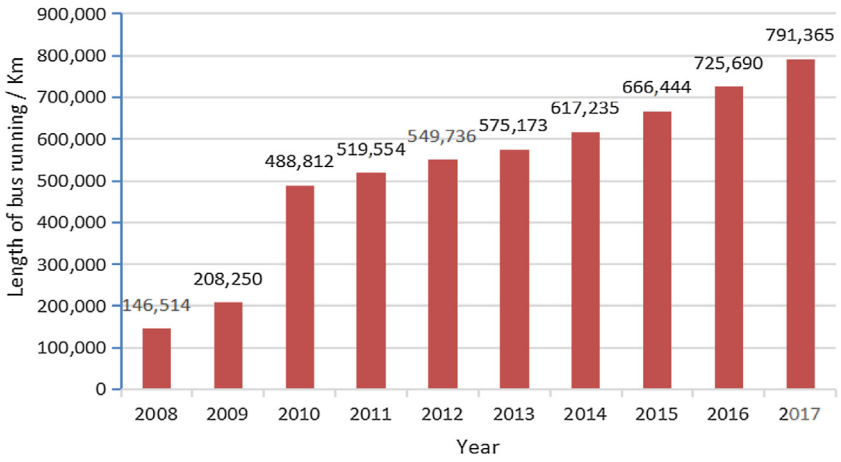

Fig. 2 – Length of bus running in Chinese cities from 2008 to 2017 [39].

Table 1 – Some well-known bus fire accidents in China from 2008 to 2018.

Date	Time	Place	Casualties	Causes
12/8/2018	4:15 PM	No.957 bus in Beijing	1 dead, no injured	Flammable items
27/4/2018	12:39 AM	No.20 bus in Beijing	1 dead, no injured	Vehicle collision
18/3/2018	1:32 PM	No.36 bus in Harbin	No dead, 1 injured	Spontaneous combustion
5/9/2016	10:45 PM	No.332 bus in Beijing	No casualty	Spontaneous combustion
5/1/2016	7:02 PM	No.301 bus in Yinchuan	18 dead, 32 injured	Arson
21/11/2014	6:20 PM	BRT No.9 bus in Liuzhou	no dead, 18 injured	Arson
15/7/2014	7:16 PM	No.301 bus in Guangzhou	2 dead, 32 injured	Arson
5/7/2014	5:03 PM	No.14 bus in Hangzhou	15 dead, 30 injured	Arson
12/5/2014	4:50 PM	No.7 bus in Yibin	1 dead, 77 injured	Arson
27/2/2014	12:32 AM	No.237 bus in Guiyang	6 dead, 35 injured	Arson
7/6/2013	6:20 PM	BRT No.1B bus in Xiamen	48 dead, 34 injured	Arson
5/8/2013	11:35 AM	No.528A bus in Urumqi	1 dead, 31 injured	Spontaneous combustion
5/6/2009	8:02 AM	No.9 bus in Chengdu	25 dead, 76 injured	Arson
5/5/2008	9:00 AM	No.842 bus in Shanghai	3 dead, 12 injured	Flammable items

Fig. 3 – The accident scene of a bus fire in Xiamen [38].

Attitudes play an important part in determining people's decision-making and behaviors (Maarten Kroesen, 2017). It has for instance been proven that safety attitude plays an essential role in a person's safety behaviors [16,17]. Considering the significant association between attitudes and behavior [18], found that safety attitudes may influence a person's behavioral intentions. A positive S&S attitude may promote the safety behavior and cut down the frequency of accidents. That is to say, passengers' attitude towards bus fires will not only determine whether they behave safely on the bus, but also whether they support and comply with formal bus safety rules.

Furthermore, safety knowledge [19] can be defined as a person's understanding of safety procedures and enough safety education and instruction, which is crucial in determining how passengers will respond to an emergency. It has been observed that safety knowledge influences safety compliance, and people with abundant safety knowledge show positive attitudes toward safety rules [20,21]. In other words, adequate safety knowledge can make people deal with the situation promptly and adequately and utilize emergency equipment well [22]. Overall, bus drivers or passengers with a negative S&S attitude and inadequate S&S knowledge may be

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at a loss and take improper measures in the fire event. Moreover, they will miss the best time to escape from certain bus fire situations. On the contrary, people with a positive S&S attitude and a lot of S&S knowledge can adequately cope with an emergency and take effective actions to protect themselves from bus fires.

Therefore, promoting people's S&S attitude and knowledge to prevent bus fire accidents is effective. In this paper, a survey towards urban residents' S&S attitude and knowledge with regard to bus fires was conducted by using self-administrated questionnaires in Fuzhou city, and the responses were further statistically analyzed.

2. Methodology

2.1. Subject

In this study, a cross-sectional survey [23–25] was conducted to evaluate the level of attitude and knowledge in relation to bus fires among residents in Fuzhou city, Fujian Province. Located in southeast of China and the provincial capital, Fuzhou is a coastal industrial and historic city with a population of about 7.0 million. Meanwhile, there are about 2559 buses and 182 running lines in this city, with 446,200 km/day and 797,100 passengers per day [26]. According to the actual situation, 200 passengers from 6 bus terminals and 10 bus stations were selected as study subject. In general, the participants sampled in this investigation differed in genders, ages, education levels, occupations, etc. (see Table 2). The survey was anonymous to lower the possibility of socially derivative responses, and 165 valid copies were received after screening out the incomplete questionnaires (valid response rate of 82.5%).

Table 2 – Socio-demographic characteristics of respondents (n = 165).

Socio-demographic characteristics		Frequency (n)	Percent (%)
Gender	Male	79	47.9
	Female	86	52.1
Age	<18	20	12.1
	19–35	102	61.8
	36–60	26	15.8
	>61	17	10.3
Educational level	Below high school	15	9.1
	High school	19	11.5
	Bachelor	109	66.1
	Master	15	9.1
	Doctor	7	4.2
Frequency of taking a bus	Frequently	62	37.6
	Occasionally	70	42.4
	Rarely	29	17.6
	Never	4	2.4
Occupation	Civil servant	25	15.2
	Company manager	18	10.9
	Company staff	21	12.7
	Student	89	53.9
	Else	12	7.3

2.2. Questionnaire

The questionnaire was composed of three sections, including socio-demographic characteristics, the passengers' S&S attitude toward bus fires, and their S&S knowledge associated with bus fires. In the first section, socio-demographic questions relate to the participants' gender, age, education level, career, and the frequency of taking a bus. Regarding the S&S attitudes, the respondents were tested with 7 items asking the extent to which they agree with the statements presented in Table 3. The responses were made on a three-point scale ranging from "agree" to "disagree" (Agree = 1, neutral = 0.5, disagree = 0). All items were described in the same direction, with high responses displaying a positive S&S attitude [27]. In the third section, the respondents were asked about safety instructions, emergency measures, and causes of bus fires. The S&S knowledge was tested through 8 true-and-false questions. Each correct answer was given 1 point, while a wrong answer was coded as 0 points.

Prior to the formal survey, a pilot test was carried out with a group of eight student passengers to check for any ambiguity or confusion about questions [28]. Accordingly, some items in the questionnaire were modified to make the statements more concrete and easier to understand. Once the participants encountered some questions during the survey, they could be provided with timely assistance for detailed explanations.

2.3. Data analysis

The obtained data was analyzed using SPSS statistical software. The frequencies and percentages in each category were computed to examine the distribution among passengers. A one-way ANOVA was utilized to investigate possible differences between S&S attitude (knowledge) and socio-demographic characteristics, such as gender, age, education level, occupation, and the frequency of taking a bus. The analysis results with a P-value of <0.05 were regarded as statistically significant. The S&S attitude and knowledge scores of each participant were determined by the summation of positive or correct answers of the tested questions [29].

3. Results and discussion

3.1. Profile of respondents

As is shown in Table 2, out of the 165 valid responses, 47.9% (n = 79) were male and 52.1% (n = 86) were female, with a proper gender proportion. Meanwhile, 61.8% (102) of the passengers were aged between 19 and 35 years, and an age of "61 and above" only accounted for 10.3%. In terms of the education level, 66.1% of the respondents had an undergraduate diploma, followed by 11.5% possessing a high school diploma. 97.6% of the participants had the experience of taking a bus, and 37.6% of the passengers take a bus frequently. As the provincial capital, there are many colleges and universities in Fuzhou city, which explains that college students formed the largest group of respondents (53.9%), followed by civil servants (15.2%). In general, the sample proportions of this study are in accordance with those of local passengers in Fuzhou city.

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Table 3 – S&S attitude of respondents (n = 165).

Statement/question	Agree		Neutral		Disagree	
	n	%	n	%	n	%
I am concerned with bus fires that take place in daily life	28	17.0	127	77.0	10	6.0
I will pay attention to the safety facilities on a bus, such as emergency exit, safety hammer, and fire extinguisher	43	26.1	101	61.2	21	12.7
I always attach importance to the safety instructions when I take a bus	21	12.7	131	79.4	13	7.9
I will be risk-aware for the arson when I am on a crowded bus	53	32.1	76	46.1	36	21.8
I will take notice of the inflammable substances and explosives that the passengers carry when I take a bus	74	44.8	74	44.8	17	10.3
I will never take a crowded bus, but wait for the next bus or choose other transportation modes	42	25.5	67	40.6	56	33.9
I will remind my companions of bus fire accidents	38	23.1	72	43.6	55	33.3

3.2. *Safety and security attitude*

S&S attitudes of the respondents are given in Table 3. It was noteworthy that only 17.0% (n = 28) of the respondents reported that they were aware of bus fires which occurred. A minority (26.1%) of respondents pay attention to the emergency exit, safety hammer, and fire extinguisher when taking the bus. Only 12.7% of the passengers recognized the importance to know the safety instructions on a bus. When encountering a crowded bus, 32.1% of the respondents indicated they would be risk-aware for an arson situation. In addition, 44.8% of the respondents will take notice of the inflammable substances and explosives that other passengers carry on the bus. 25.5% of the respondents acknowledged that they will never take a crowded bus, but wait for the next bus or choose another transportation mode. Moreover, 23.1% of the passengers expressed that in a crowded situation they will remind their co-passengers of possible bus fire accidents.

3.3. *Safety and security knowledge*

The respondents' S&S knowledge is displayed in Table 4. The results show that only 39.4% of the participants were familiar with the safety instructions on a bus. The minority of the respondents (34.5%) know how to operate a fire extinguisher (installed on a bus), while 30.3% of them can utilize the emergency door knob and roof window. Concerning the safety hammer, only 44.8% of the passengers know how to break the bus windows to escape from the fire by hitting the four corners of window vertically (see Fig. 4). In addition, more than half (59.4%) of the respondents would recognize the inflammable substances and explosives which are prohibited on a bus. Meanwhile, they know how and who to call during fire accidents. Whereas, 70.9% of the respondents cannot understand that the bus may catch fire more frequently due to spontaneous combustion in hot weather. In general, only a small part (21.8%) of the participants know some basic emergency response information.

3.4. *Correlation between S&S attitude (knowledge) and demographic characteristics*

The overall scores of S&S attitude and knowledge can be obtained by summation of the positive or correct answers in the tested questions [23,29]. As is shown in Table 5, the calculated average scores of S&S attitude and knowledge among the participants were 57.3% and 43.6%, respectively. It can be observed that gender did not lead to any effect on the respondents' S&S attitude and knowledge ($P = 0.267 > 0.05$, $0.435 > 0.05$). In contrast, the educational level significantly influences the S&S attitude and knowledge of the respondents ($p = 0.021$, $p < 0.001$), showing a positive correlation. In other

Table 4 – S&S knowledge of respondents (n = 165).

Statement/Question	Correct		Incorrect	
	n	%	n	%
Are you familiar with the safety instructions on a bus? (Yes, No)	65	39.4	100	60.6
Do you know the operation procedures of the fire extinguisher that is installed on a bus? (Yes, No)	57	34.5	108	65.5
Do you know how to operate the emergency door knob and roof window? (Yes, No)	50	30.3	115	69.7
Do you know how to break the bus windows to escape from the fire using a safety hammer? (**hit the four corners of window vertically**, hit the four corners of window with a slope, hit the middle of window vertically, hit the middle of window with a slope)	74	44.8	91	55.2
Do you know the inflammable and explosives (such as paint and gasoline) are prohibited to get on the bus? (Yes, No)	98	59.4	67	40.6
Do you know the bus catches fires easily due to spontaneous combustion in hot weather? (Yes, No)	48	29.1	117	70.9
Do you know how to call the alarm telephone when the bus catches fire? (Yes, No)	97	58.8	68	41.2
Do you know some basic emergency knowledge about bus fire? (Yes, No)	36	21.8	129	78.2

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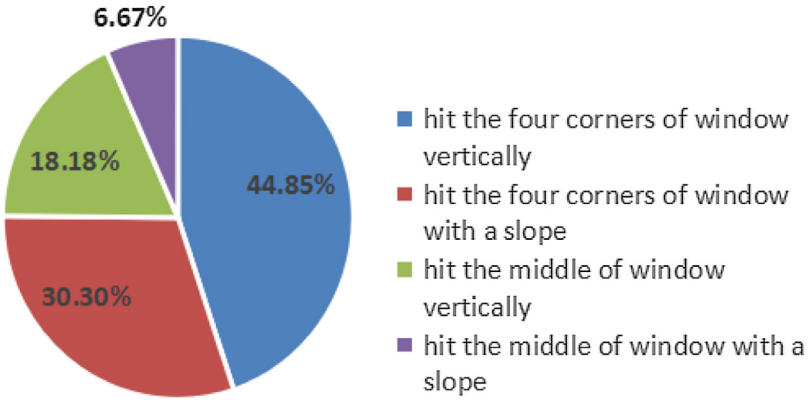

Fig. 4 – The distribution of "How to use a safety hammer?".

words, passengers who receive a higher education level will attach more importance to bus fires and can better take effective measures in case of an emergency. Similarly, the passengers who take a bus frequently are more likely to own higher S&S attitude and knowledge scores ($P = 0.027$, $P < 0.001$). Those who seldom or never take buses will express negative attitudes and may not know what to do towards bus fires. In terms of age, participants aged between 36 and 60 gain the highest knowledge score (49.4%, $P = 0.035$), while it seemed that the age did not have significant influence on S&S attitudes. Additionally, results show that the passengers working in government and serving as a manager in a company scored higher in attitude (60.4%, 64.4%, respectively) than the staff and students (53.8%, 57.8%, respectively).

In general, the participants' education level and the frequency of taking a bus show significant effects on their S&S knowledge and attitudes scores. Whereas, no significance can be found between the corresponding scores and the gender.

4. Discussion

This study aims to explore the level of bus passengers' S&S attitude and knowledge towards bus fires in China. According to the classification of "good" (more than 60%) and "poor" (less than 60%) [25], the overall scores of the respondents' S&S attitude (57.3%) and knowledge (43.6%) are not satisfactory. In order to heighten passengers' S&S attitude and knowledge, local governments and transportation departments should formulate a variety of safety strategies. These can range from regulations on bus design to S&S education plans for bus

Table 5 – The association between socio-demographic characteristics and S&S attitude (knowledge) of respondents.

Overall scores (%)		Total	Safety attitude		Safety knowledge	
			% 57.3	P value 0.267	% 43.6	P value 0.435
Gender	Male	79	58.2		44.9	
	Female	86	56.6		44.2	
Age	<18	20	53.5	0.198	37.5	**0.035**
	19–35	102	58.3		45.3	
	36–60	26	56.2		49.4	
	>61	17	58.2		39.2	
Educational level	Below high school	15	52.0	**0.021**	31.1	<**0.001**
	High school	19	51.6		37.7	
	Bachelor	109	57.5		44.3	
	master	15	64.0		56.7	
	Doctor	7	67.1		69.0	
Frequency of taking a bus	Often	62	60.8	**0.027**	50.0	<**0.001**
	Occasionally	70	57.6		43.1	
	Seldom	29	54.5		38.5	
	Never	4	50.0		29.2	
Occupation	Civil servant	25	60.4	0.061	44.7	**0.011**
	Enterprise manager	18	64.4		55.6	
	Enterprise staffs	21	53.8		34.9	
	Student	89	57.8		46.4	
	Else	12	54.2		30.6	

Bold values mean: Statistically significant ($p < 0.05$).

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passengers. To prevent bus fires resulted from spontaneous combustion, some investment in bus maintenance should be increased to reduce the failures in electrical, fuel, and exhaust system on the buses [9].

It has been recognized that the purpose of safety education is to provide urban residents with accurate bus fire safety knowledge, promote a positive attitude, and influence passengers' behaviors once an emergency occurs [15]. Effective safety education addresses known risk and protective factors [30]. Therefore, in today's digital era, some creative and active approaches are necessary to encourage new means to teach bus fire safety in a stimulating way. For example, the LED screen on a bus is a good medium to play a safety propaganda film which can attract the passengers' attention. In addition, mass media like mobile phones and internet are also good tools to spread safety knowledge [22,31]. Based on the "Traffic Safety's Day Of China" and "Safety Month" theme activities, bus fire safety information can be disseminated by We-Chat, micro-blog, QQ and other media. Considering community safety has a direct goal of promoting the residents' safety culture and the arts are associated with entertainment and enlightenment, it is a significant way to combine the community arts with community safety actions to improve the public's attitude and knowledge on bus fire safety [32]. As the traditional safety symbols and brochures are usually static and spatially limited in utilization, the bus fire safety information can be incorporated into television shows [33]. Due to a large proportion of accidents caused by arson, the government can organize some anti-terrorism activities toward bus fires to enhance public S&S awareness.

Some students display limited safety knowledge towards bus fires due to a lack of S&S learning, practice, and educational circumstances. S&S education at school can make a favorable effect on the youngsters' S&S knowledge and behavior intentions [34,35], so education programs targeting to enrich the knowledge on S&S behavior within a transportation environment are vital in developing an adequate S&S attitude with respect to bus fires. Moreover, it is a good way to setting up some S&S education curriculum about S&S rules and the procedures to follow in case of fire emergency at school to reinforce the students' S&S attitude and knowledge.

Additionally, bus companies may think about strengthening the S&S management of the drivers and passengers, and create a good S&S atmosphere. Before getting on the bus, the passengers can be reminded about S&S requirements to ensure that they are familiarized with the location and use of emergency exits, the safety hammer, using a fire extinguisher, and other emergency equipment. According to relevant laws, persons carrying illegal inflammable substances and explosive materials should be handled by law enforcement and be punished. For bus drivers, it is important to strengthen their legislation sense, technical skills, S&S awareness and professional ethics.

5. Conclusions

Since the urban population grows rapidly, buses have become the main mode of public transportation in China. However, frequent bus fire accidents result from various factors posing a serious threat to people's daily life in recent years. This research has investigated the residents' S&S attitude and knowledge towards bus fires by using questionnaires in Fuzhou city. According to statistical results, it has been found that a minority of respondents are concerned with bus fire S&S in their daily lives. Many passengers pay not much attention to the safety instructions when taking a bus. With respect to S&S knowledge, only a few participants admitted they can operate the emergency facilities in a correct way, including the fire extinguisher, safety hammer, automatic fire alarms, and roof window, etc. In general, the S&S attitude and knowledge differed by the respondents' gender, age, education level, occupation, and frequency of taking a bus. The participants' education level and the frequency of taking a bus have a significant effect on the perceived S&S attitudes and knowledge.

This is the first study to focus on S&S attitude and knowledge of the public towards bus fires in China. The research results may lay the foundation for local governments, bus transport operators, and relevant safety organizations to establish a series of safety policies or regulations with respect to bus fires. In addition, the present questionnaire should be made better to obtain some latent influence factors of passengers' perceived S&S attitude and knowledge regarding bus fires. Similarly, more items in the questionnaire should be modified at the management and group level to obtain credible results [36]. Also, further research on the correlation between passengers' safety and security (S&S) knowledge, attitude, and behavior should be carried out. It is necessary to improve the people's safety and security (S&S) attitude and knowledge by safety education in daily life or work, so the corresponding effects also need to be examined in a future study.

Conflict of interest

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

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REFERENCES

[1] Willstrand, Brandt OJ, Svensson R. Detection of fires in the toilet compartment and driver sleeping compartment of buses

and coaches-Installation considerations based on full scale tests. Case Stud Fire Saf 2016;5:1–10.
[2] Cafiso S, Graziano AD, Pappalardo G. Road safety issues for bus transport management. Accid Anal Prev 2013;60:324–33.
[3] Salonen AO. Passenger's subjective traffic safety, in-vehicle security and emergency management in the driverless shuttle bus in Finland. Transport Policy 2018;61:106–10.
[4] Sam EF, Brijs K, Daniels S, Brijs T, Wets G. Public bus passenger safety evaluations in Ghana: a phenomenological constructivist exploration. Transportation Res F 2018;58:339–50.
[5] Khoo HL, Ahmed Muaid. Modeling of passengers' safety perception for buses on mountainous roads. Accid Anal Prev 2018;113:106–16.
[6] Lakshay, Bolia NB. Operating strategies of buses for mass evacuation. Saf Sci 2019;111:167–78.
[7] Lundin J. Quantification of a safety target for an underground CNG bus terminal in Stockholm. Fire Saf J 2019;104:57–66.
[8] Bi K, Qiu R, Jiang Y, Zheng J. Reconstruction of a bus fire based on numerical simulation. J Univ Sci Technol China 2010;40(10):387–97.
[9] Liu Y, Wu P, Ho JK, Hua HP, Chen HJ, Cen Y, et al. Epidemiology of bus fires in mainland China from 2006 to 2015. Burns 2018;44:995–9.
[10] Hu H, Wang J, Han C. Experience in managing an urban massive burn incident: the Hangzhou bus attack on 5 July 2014. Burns 2016;42:169–77.
[11] Cheng Y, Huang X, Xie S, Cheng C, Chen X. Analysis of bus fire situation and research on the response measures. Fire Sci Technol 2015;34(2):267–9.
[12] Kang Q, Zhao L, Li Z, Cao F. Numerically simulated study on the characteristic features and spreading process of the bus fire. J Safety Environ 2015;15(1):107–10.
[13] Huang X, Wu D, Xie S, Jiang W, Wang D, Tian K. Analysis and research on fire load and fire risk of bus garage. Fire Sci Technol 2017;37(2):269–72.
[14] Shin M, Lee HS, Park M, Moon M, Han S. A system dynamics approach for modeling construction workers' safety attitudes and behaviors. Accid Anal Prev 2014;68:95–105.
[15] Chang YH, Liao MY. The effect of aviation safety education on passenger cabin safety awareness. Saf Sci 2009;47:1337–45.
[16] Warmerdam A, Newnam S, Wang Y, Sheppard D, Griffin M, Stevenson M. High performance workplace systems' influence on safety attitudes and occupational driver behaviour. Saf Sci 2018;106:146–53.
[17] Loosemore M, Malouf N. Safety training and positive safety attitude formation in the Australian construction industry. Saf Sci 2019;113:233–43.
[18] Rundmo Hale. Managers' attitudes towards safety and accident prevention. Saf Sci 2003;41:557–74.
[19] Hofmann DA, Jacobs R, Landy F. High reliability process industries: individual, micro, and macro organizational influences on safety performance. J Safety Res 1995;26(3):131–49.
[20] Kwon O-J, Kim Y-S. An analysis of safeness of work environment in Korean manufacturing: the "safety climate" perspective. Saf Sci 2013;53:233–9.
[21] Wang C, Xu C, Xia J, Qian Z. The effects of safety knowledge and psychological factors on self-reported risky driving behaviors including group violations for e-bike riders in China. Transp Res F Traffic Psychol Behav 2018;56:344–53.
[22] Chittaro L, Corbett CL, McLean GA, Zangrando N. Safety knowledge transfer through mobile virtual reality: a study of aviation life preserver donning. Saf Sci 2018;102:159–68.
[23] Bou-Mitri C, Mahmoud D, El Gerges N, Jaoude MA. Food safety knowledge, attitudes and practices of food handlers in Lebanese hospitals: a cross-sectional study. Food Control 2018;94:78–84.
[24] Ovca A, Jevšnik M, Kavčič M, Raspor P. Food safety knowledge and attitudes among future professional food handlers. Food Control 2018;84:345–53.
[25] Ruby GE, Zainal Ungku, Abidin UF, Lihan S, Jambari NN, Radu S. A cross sectional study on food safety knowledge among adult consumers. Food Control 2019;99:98–105.
[26] Zhou MQ, Lin JL. Thinking of the safety management of public bus operation. Peoples Public Transport 2017;11:70–3.
[27] Glendon AI, Litherland DK. Safety climate factors, group differences and safety behaviour in road construction. Saf Sci 2001;39:157–88.
[28] Chan ESW, Lam D. Hotel safety and security systems: bridging the gap between managers and guests. Int J Hosp Manag 2013;32:202–16.
[29] Osaili TM, Obeidat BA, Hajeer WA, Al-Nabulsi AA. Food safety knowledge among food service staff in hospitals in Jordan. Food Control 2017;78:279–85.
[30] Mulvaney CA, Watson MC, Errington G. Safety education impact and good practice: a review. Health Educ 2012;112(1):15–30.
[31] Yang F. Exploring the information literacy of professionals in safety management. Saf Sci 2012;50(2):294–9.
[32] Murray M, Tilley N. Promoting safety awareness in fishing communities through community arts: an action research project. Saf Sci 2006;44:797–808.
[33] Warton NM, Brander RW. Improving tourist beach safety awareness: the benefits of watching Bondi rescue. Tour Manag 2017;63:187–200.
[34] Silla A, Kallberg VP. Effect of railway safety education on the safety knowledge and behaviour intention of schoolchildren. Eval Program Plann 2016;55:9–16.
[35] Riaz MS, Cuenen A, Dhondt S, Craps H, Janssens D, Wets G, et al. Evaluation of a road safety education program based on driving under influence and traffic risks for higher secondary school students in Belgium. Safety 2019;5(34):1–18.
[36] Henning JB, Stufft CJ, Payne SC, Bergman ME, Mannan MS, Keren N. The influence of individual differences on organizational safety attitudes. Saf Sci 2009;47:337–45.
[38] Baidu.cn. "6.7" Xiamen bus fire case. 2018. . (in Chinese, Accessed 01.29. 2019) https://baike.baidu.com/item/6%C2%B77%E5%8E%A6%E9%97%A8%E5%85%AC%E4%BA%A4%E8%B5%B7%E7%81%AB%E6%A1%88/5844872?fr=aladdin.htm.
[39] National Bureau of Statistics of China, 2019. http://data.stats.gov.cn/search.htm?s=%E5%85%AC%E4%BA%A4%E8%BD%A6. (in Chinese) [Accessed 25 January 2019].

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