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ADHERENCE TO MASK WEARING ON PUBLIC TRANSPORT DURING THE COVID-19 PANDEMIC AND INFLUENTIAL FACTORS: THE CASE OF HANOI

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Abstract. In response to little known about the use of face masks for public transport passengers in developing countries, this study investigates the prevalence of using masks and using masks correctly together with influential factors. Using 570-passenger data collected on the whole bus network from 7 September to 3 October 2020 in Hanoi, the authors found that 100% of users wore masks; however, about 11% failed to wear masks correctly. As regards factors, passengers who are old, rarely ride by bus, take heavy luggage, travel with other(s) were more likely to use masks incorrectly. Having a health issue encouraged the correct use of masks. Attitudes towards the COVID-19 were significant factors. The higher levels of agreement with the acute danger of COVID-19 and the risk of infection from the public were involved in the higher likelihood of the correct mask wearing. Notably, over time with no community transmission of the coronavirus, the likelihood of incorrect use of masks was more inclined to increase. To address the wrong utilization of masks on buses, the role of ticket conductors in reminding and asking users using masks incorrectly should be enhanced. Additionally, authorities should issue messages and implement campaigns to encourage citizens to wear in public spaces on a regular basis, particularly when the adherence reduces over the time without community transmission of COVID-19. Although not covering all aspects representing the incorrect mask wearing, this study is one the first research on the incorrect use of masks, thus extending the literature on how public transport users respond the effects of COVID-19.

Keywords: COVID-19 pandemic, mask wearing, bus user in Hanoi.

1. INTRODUCTION

COVID-19 (i.e., COronaVIrus Disease of 2019), which is caused by a new coronavirus (i.e., SARS-CoV-2) first detected in Wuhan, China in December 2019, has rapidly and unprecedentedly spread worldwide to turn into a pandemic [1, 2]. Prior to the COVID-19, the 21st century has witnessed a number of pandemics, including SARS in 2003, H1N1 in 2009, MERS in 2012, and Ebola in 2014 [3]; however, COVID-19 is the most severe health crisis in terms of infections, deaths, and infected areas. According to [4], the outbreak of this pandemic has resulted in 46.4 million infections, approximately 1.2 million deaths in over 210 countries. Besides disastrous effects on human health, COVID-19 has exerted destructive impacts on various sectors, such as energy consumption, labor market, food security, supply chain management, tourism [5, 6]. Among affected disciplines, transport has attracted close attention of researchers because of its important role in spreading pandemics and significant changes in the use of travel modes due to the fear of infection and the implementation of social distancing [7, 8].

The travel mode uses of citizens have changed significantly during the period of COVID-19 with the dramatic increase in utilizing private vehicles. By contrast, public transport shows the substantial decrease in ridership [9], coming from the structure of its vehicles (e.g., bus and train) and its operation. Coupled with touching infected surfaces, the respiratory of COVID-19 can spread via droplets when talking, coughing, and sneezing [10]. Public transport vehicles, which are confined environment wherein physical contact is difficult to avoid, particularly at peak hours [7], may boost significantly human interactions and the exposure to virus, thus possibly boosting the dissemination of infectious diseases [11]. Recent empirical studies have well supported the association of COVID-19 infection with traveling by public transport. Zheng et al. [12], for example, found that the frequency of flights, trains, and buses from Wuhan was positively associated with the daily and the cumulative number of COVID-19 cases in other Chinese cities.

To keep public transport from being infected with the coronavirus, one of the most widely applied measures is wearing face masks [13]. Around the academia, there have been several studies on the adherence to the mask wearing guideline [14-16]. However, no study has focused on factors associated with the incorrect use of bus passengers in a city where wearing mask is mandatory. To fill this research gap in part, this study concentrates on bus users' implementation of using masks on board in Hanoi, the capital of Vietnam. The specific research questions are as follows:

- What is the prevalence of using masks on buses?
- What is the prevalence of incorrect use of masks on buses?
- What are factors associated with the incorrect use of masks on buses?
- What are policy implications drawn from the case of Hanoi?

This study contributes to the existing literature in a number of ways. First, while previous studies rely on data of the third party, such as mobile phone data and operational data of transit [17, 18], this study employs original self-reported data of bus users. Second, this study, on the one hand, emphasize the strict adherence to mask wearing. It, on the other hand, emphasize a significant rate (11%) of users wear masks wrongly. Third, this research provides new insight into factors affecting the incorrect use of mask on buses. Fourth, this study proposes policy implications to protect buses better from the coronavirus.

The rest of this paper is structured as follows. Section 2 reviews earlier studies on the preventive measures with a focus on using masks in the era of COVID-19. Next, data collection and analysis method are described in Section 3. Results of the prevalence and discussions about factors affecting the incorrect use of masks are presented in Section 4. Finally, policy implications and conclusions together with future research directions close this paper.

2. RELATED RESEARCH ON PREVENTIVE MEASURES

In the battle against COVID-19, social distancing and wearing masks have been implemented broadly. Social distancing is involved in mandatorily keeping a safe distance among passengers when utilizing public transport. The distance threshold regulated varies across public transport systems in cities, such as 1 m in Milan (Italy), 1.5 m in Brussels (Belgium), or 6ft (1.8 m) in New York (the US) [19]. Physical distancing conflicts with the concept of public transport because it leads to the reduced capacity of vehicles [8]. In Shenzhen (China), carrying less than 50% of the normal capacity is advised while in Nigeria, for a row with 5 seats, no more than three passengers should be transported [14]. The role of social distancing in limiting close contacts thus in limiting the number of infections is undeniable; nevertheless, it may not be inadequate to stop the spread of virus within the vehicle environment [13].

While the effectiveness of social distancing is widely accepted, wearing face masks in public spaces is a controversial debate, especially in the pandemic's infancy, because of the World Health Organization's guideline to use masks for symptomatic people only [13]. However, over half of infected cases may be unascertained with asymptomatic and mildly asymptomatic signs [20]; wearing masks in the public places was then suggested and even obligatory for numerous countries, such as China, Singapore, where the pandemic, despite occurring soon, has been controlled effectively [21]. The (surgical) face masks have been found to prevent the human-to-human transmission of coronavirus [22]. Fabric masks made from cotton, silk, chiffon, and flannel are able to filter over 80% and over 90% of particles <300 nm and >300 nm, respectively [23]. Mandating the use of masks enables to a considerable decrease in the growth in daily COVID-19 rates [24].

At the national level, the study [15] conducted a nation-wide internet-based survey with 2141 samples collected in April 2020 in Japan. The prevalence of using masks was about 80%. Among respondents wearing masks, 83.5% wore masks to cover both their mouths and noses while only 23.1% of respondents follow all appropriate measures for the correct use of face masks (e.g., covering both mouth and nose, avoiding touching mask, removing the mask by appropriate technique, replacing the mask when it becomes damp, not re-using the mask). The lower compliance rates were witnessed for males and persons from low household incomes. The authors emphasized that the cultural habit of using medical masks daily did not go together with a habit of correct use.

Using an online questionnaire administered from 31 March to 6 April, 2020, Nguyen et al. [16] assess the adherence of Vietnamese citizens to safety measures, like social distancing, wearing a face mask, regular handwashing, body temperature check, and disinfecting mobile phones). The prevalence of wearing a face mask when going outside was nearly complete (99.5%). A person living in a municipality is more inclined to adhere to the preventive measures.

Using data of bus passengers in Accra (Ghana), the authors of [14] reported a very low rate of compliance with the guideline for wearing face masks at only 12.6%. A higher degree of

disregard for the policy on face masks was seen in evenings compared to in the mornings. Many drivers observed failed to wear masks because they usually called commuters. The poor adherence to mask wearing would stem from no penalties being imposed to passengers not following the guideline. To put it another way, wearing masks is not obligatory in Ghana. The limitation of this study is to only observe whether a passenger used masks or not, but omit the correctness of mask wearing.

3. DATA AND METHOD

3.1. Data collection

Data collection for this study was carried out in Hanoi from 7 September to 3 October 2020 (Figure 1). This survey time was right after the end of the third wave of COVID-19 whose last confirmed community case detected on September 2.

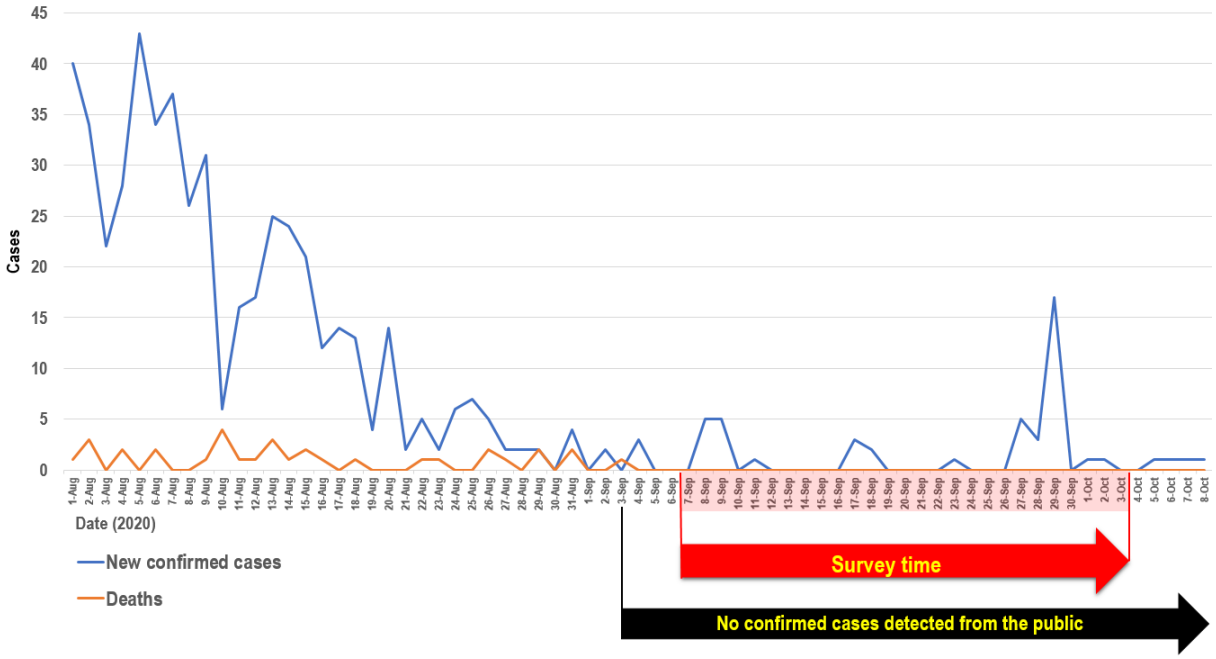

Figure 1. The time of data collection.

To attain a representative sample of bus users, surveyors, who are students of University of Transport and Communications, travelled to implement face-to-face interviews with passengers on of 51 routes, of which 24, 2, 25 run within the urban area, within the non-urban area, and across both urban and non-urban areas, respectively (Figure 2). This distribution is well compatible with the percentages of routes classifying based on the Hanoi bus's operational scope in Hanoi. Surveys were undertaken both on weekdays and at weekend to attain the temporal representation. There were two or three surveyors on each bus to ask passengers. To protect the health of interviewers, they were equipped with gloves and masks with a recommendation for using hand sanitizer frequently.

The questionnaire included four main parts. The first requests information on the frequency of using bus, the use of hand sanitizer, the carriage of personal hand sanitizer, the carriage of heavy luggage, whether the respondent goes with others, and the ticket type used. The second comprises attitudinal statements about hand sanitizer, facemasks, COVID-19, concerns when travelling bus (e.g., pickpocketing). The five-point Likert scale (strongly disagree – strongly

degree) was used to measure responses to such statements. The third requires a participant to declare their personal information, including age, gender, occupation, living area, educational level, and the existence of a health problem. The fourth, completed by the interviewer, contains background information of the survey including date, the bus route number and whether a passenger wears a face mask correctly or not.

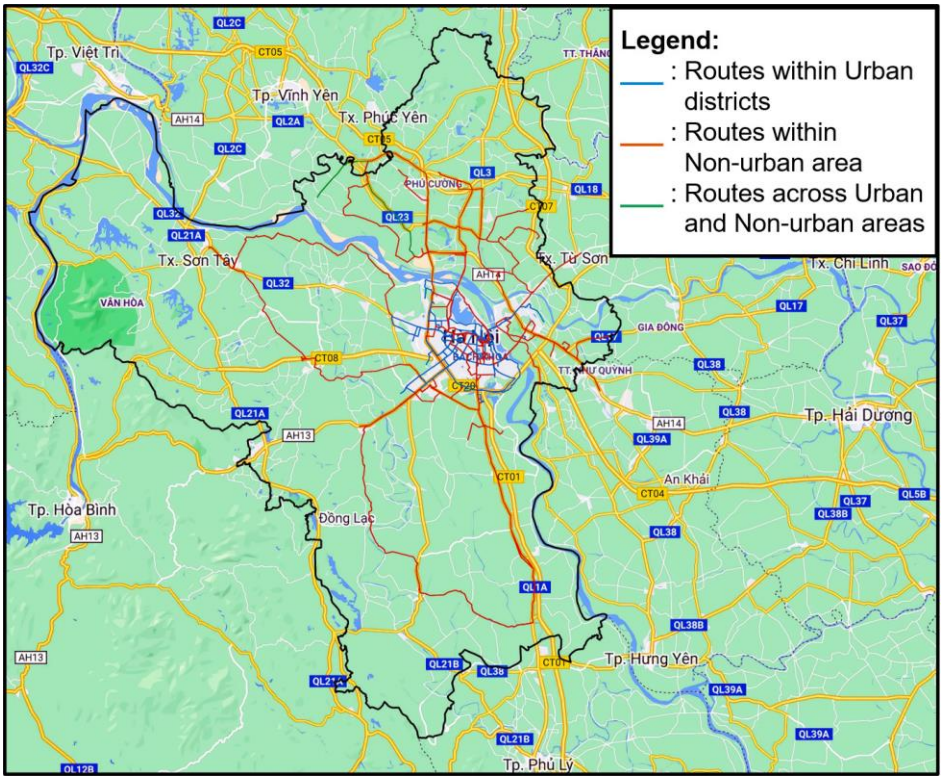

Figure 2. Distribution of bus routes surveyed.

After four weeks of collection, we decided to end the surveys. Among 602 samples collected, 32 incomplete questionnaires were excluded and 570 responses were eligible for further analyses. According to [25], the rule of thumb to determine the adequate sample size for testing the multiple correlation is $N \geq 50 + 8m$ (where m is the number of independent variables). Our questionnaires had 35 questions, some of which were not used and thus not indicated here; therefore, the minimum size should be larger than 50+8*35=330. Accordingly, 570 responses would be enough for the further logit regression modelling.

3.2. Method

Collected data first were analyse through descriptive statistics to show characteristics of samples and the prevalence of wearing masks and of wearing masks correctly.

The well-known binary logistic regression modelling was applied for this study to explore factors associated with the incorrect use of masks. The dependent variable was whether a passenger wore a mask correctly. The correctness refers to the fact that a mask covers both mouth and nose of passenger and is not wore upside down. We only considered two criteria instead of various measures as mentioned in [15] since it would be easy for surveyors to observe and note the status of using masks. Others (e.g., removing masks by appropriate techniques or only using a mask once or using a medical mask) need the report of participants. In case of a face-to-face survey, a participant may not be willing to declare a reliable answer. Besides, the

authorities only encouraged the use of masks rather than strictly requiring medical masks.

The independent variables include: gender, age, occupation, education, having a health problem, the frequency of using bus, the carriage of heavy luggage, the ticket type used, travelling with others, 'COVID-19 is a dangerous disease', and 'the risk of infection from the public (e.g., restaurants, markets) is high'.

After the binary logit model was estimated, variance inflation factors (VIFs) of independent variables were computed to diagnose whether the problem of multicollinearity occurs. All statistical analyses were undertaken using Stata 15.0.

4. RESULTS AND DISCUSSIONS

4.1. Descriptive statistics

Table 1 shows the breakdown of the samples. The gender-based difference was marginal. The vast majority of respondents were younger than 30 years old (74%). As regards occupation, students accounted for the largest percentage (65%). Compatible with the distribution of jobs, the rate of having no a university degree was at 68%. Approximately 61% of participants were interviewed when travelling on bus route running within the urban districts. Among those questioned, regular users made up the highest share at 35%, followed by frequent passengers with 35%. The lowest share was seen for passengers travelled by bus the first time or rarely. Monthly tickets (55%) were used the most frequently while the prioritized tickets were utilized the least frequently (6%). Only 11% took heavy luggage within the trips surveyed. Nearly three-quarters travelled alone while 16% had a health issue. The numbers of participants in four weeks were close together with a slightly higher figure for the first week (30%) compared to those of other weeks. The mean of responses to attitudinal statements reveals that bus passengers agreed with the risk of infection from the public places and the acute danger of COVID-19.

Although students and pupils have been indicated as the main passengers of bus services in Hanoi [26], the rate of this group (65%) in this sample is relatively high. The same is true for the youngest group (under 30 years old) with the percentage at 74.7%. On the one hand, these high percentages can be explained that because of aiming at protecting health, many old passengers such as the retired chose staying at home or travelled by another mode rather than a bus, which is favourable condition for the spread of COVID-19. Consequently, the total number of passengers decreased while the number of students, probably due to having no alternative mode to bus, remained unchanged, resulting in the increase in the share of students in the ridership distribution. On the other hand, bias may occur in the survey because young passengers would be more willing to participate in the survey than other age groups. In this sense, the samples of respondents aged under 30, particularly students and pupils, would be overrepresented to some extent.

Based on the comparison of variables between the samples of using masks correctly and that of wearing masks wrongly (Table 1), some potential variables governing the behaviour of wearing masks were as follows: (1) Age, (2) Education, (3) Route surveyed, (4) Bus use frequency, (5) Ticket type, (6) Taking heavy luggage, (7) Go with others, (8) Having a health issue, (9) Week of responses, (10) COVID-19 is a dangerous disease, (11) The risk of infection from the public is high.

Table 1. Breakdown of the samples.

Variables	**Values**	**Sample (N=570)**		**Proper use of mask**		**Improper use of mask**	
		Freq.	*%*	*Freq.*	*%*	*Freq.*	*%*
Gender	Male	280	49.12	245	48.51	35	53.85
	Female	290	50.88	260	51.49	30	46.15
Age	< 30	426	74.74	393	77.82	33	50.77
	30-45	58	10.18	50	9.9	8	12.31
	> 45	86	15.09	62	12.28	24	36.92
Occupation	Students/pupils	368	64.56	337	66.73	31	47.69
	(Self-)Employed	104	18.25	91	18.02	13	20
	Others	98	17.19	77	12.28	21	32.31
Education	University degree or higher	185	32.46	220	43.56	25	38.46
	No university degree	385	67.54	285	56.44	40	61.54
Route surveyed	Completely in urban areas	347	60.88	317	62.77	30	46.15
	Not completely in urban areas	223	39.12	188	37.23	35	53.85
Bus use frequency	Regular (>= 4 days/week)	202	35.44	195	38.61	7	10.77
	Frequent (2-3 days/week)	143	25.09	130	25.74	13	20
	Sometimes (2-4 times/month)	117	20.53	100	19.8	17	26.15
	Rarely (2-4 times/year) or the 1st time	108	18.95	80	15.84	28	43.08
Ticket type	Single ticket	220	38.6	179	35.45	41	63.08
	Monthly ticket	314	55.09	295	58.42	19	29.23
	Prioritized ticket	36	6.32	31	6.14	5	7.69
Taking heavy luggage	Yes	61	10.7	42	8.32	19	29.23
	No	509	89.3	463	91.68	46	70.77
Go with other(s)	Yes	144	25.26	142	28.12	2	3.08
	No	426	74.74	363	71.88	63	96.92
Having a health issue	Yes	92	16.14	76	15.05	16	24.62
	No	478	83.86	429	84.95	49	75.38
Week of response	First week	170	29.82	154	30.5	16	24.62
	Second week	118	20.7	116	22.97	2	3.08
	Third week	152	26.67	135	26.73	17	26.15
	Fourth week	130	22.81	100	19.8	30	46.15
COVID-19 is a dangerous disease		4.55*	0.73**	4.560*	0.738**	4.508*	0.664**
The risk of infection from the public (e.g., restaurants, markets) is high		4.29*	0.77**	4.315*	0.786**	4.096*	0.583**
Using a mask correctly	Yes	505	88.6	505	100	-	-
	No	65	11.4	-	-	65	100

* refers to *mean*

** refers to *standard deviation*

4.2. The prevalence of using masks and using masks correctly on buses

Total passengers on buses wore masks. This rate was similar to the prevalence of wearing masks at 99.5% in Vietnam, 98% in China [16] but much higher than 12.6% in Ghana [14]. This result was predictable because wearing masks is mandatory for bus passengers in cities of Vietnam and China. Moreover, using masks once travelling has been ubiquitous in Vietnam due to the severe air pollution. Although all respondents used masks, 11% failed to wear mask correctly. Specifically, their masks did not cover their mouths and noses, or their masks were worn upside down.

4.3. Factors associated with the incorrect use of face masks

For exploring factors associated with the correct use of masks, all potential variables were added to estimate the binary logit model. Afterward, insignificant variables were removed. The remainder of variables was then used to re-estimate the logit model wherein all of these variables were significant again. Therefore, the results of this model can be utilized to analyse influential factors. To diagnose the risk of multicollinearity, VIFs of independent variables were estimated. Because all VIFs were under 4, the multicollinearity problem was eliminated [27]. With Pseudo R2=0.3284 (Table 2) falling into the recommended range between 0.2 to 0.4 [28], the goodness of fit of the model are good.

Table 2. Results of binary logit modelling.

Variables	Coef.	P_value
Age *(ref=under 30)*		
30-45	-0.291	0.568
≥ 45	-1.860**	0.000
Education *(ref=* University degree or higher*)*		
No university degree	-1.061**	0.006
Bus use frequency *(ref=* Regular (>= 4 days/week)*)*		
Frequent (2-3 days/week)	-0.551	0.317
Sometimes (2-4 times/month)	-0.763	0.140
Rarely (2-4 times/year) or the first time	-1.698**	0.001
Taking heavy luggage *(ref=Yes)*		
No	1.624**	0.000
Go with other(s) *(ref=No)*		
Yes	-2.458**	0.002
Having a health issue *(ref=yes)*		
No	0.671*	0.092
Week of response *(ref=first week)*		
Second week	2.134**	0.009
Third week	-0.173	0.696
Fourth week	-1.701**	0.000
COVID-19 is a dangerous disease	0.680**	0.014
The risk of infection from the public (e.g., restaurants, markets, buildings) is high	0.655**	0.019
_cons	4.506**	0.002
Number of observations	570	
Log likelihood	-135.85161	
LR chi2(14)	132.85	
Prob > chi2	0.0000	
Pseudo R2	0.3284	

Dependent variable = 1 (Correctly use masks), 0 (Wrongly use masks).

*, **: Statistically significant at 0.1, 0.05 levels, respectively.

Regarding factors, although a previous study highlighted the better adherence to preventive measures for females [15]; however, gender was not a significant independent variable in this current research.

The oldest passengers (coef=-1.860) were less likely to wear correctly compared to the youngest passengers. In this sense, older users tended to focus on wearing masks rather than on how to wear them correctly. A reason would be that an old person may have breathing problems; hence, (s)he did not wear masks to cover both his/her nose and mouth continuously during the whole of bus trip.

Having no university degree (coef=-1.061) was associated with the less likelihood of wearing masks correctly. Compared to a regular bus user, a passenger rarely commuting by bus (coef=-1.698) was less likely to wear masks correctly. Hence, a user hardly travelling by bus seemed to wear masks to be eligible for boarding but lack adequate attention to the correct use of masks.

Taking heavy luggage was negatively associated with the correct use of masks. It can be interpreted that carrying heavy luggage required more (physical) efforts; therefore, the passenger was more inclined to lower his/her mask under his/her nose.

Going with other(s) (coef=-2.458) increased the possibility of using masks incorrectly. It is understandable because masks may serve as barriers to the communications between a passenger and his/her friend(s)/colleague(s)/relative(s) on buses.

Having a health problem (coef=0.671) encouraged the correct use of masks, albeit with a weak relationship (p_value=0.092). A user with a health issue was more likely to pay more attention to preventive measures because COVID-19 can deteriorate the existing disease(s) to destroy the health of patients.

Regarding attitudinal variables, unsurprisingly, the higher levels of agreement with the acute danger of COVID-19 (coef=0.680) and the risk of infection from the public (coef=0.655) were involved in the higher likelihood of the correct use of masks.

The result related to the week of responses provides interesting insights. Bus passengers in the second week (coef=2.134) were more likely to wear masks correctly. By contrast, compared to the responses collected in the first week of survey, those gathered in the fourth week (coef=-1.701) were less likely to adopt the correct use of masks. It is important to note that because the first survey was carried out right after the last confirmed case in the community was recorded. Hence, during the two first weeks of surveys, the national and local governments kept reminding citizens of complying with safety guidelines. Consequently, bus users tended to strictly and carefully implement mask wearing. However, the lower level of adherence occurred in the fourth week since no community transmission was detected for a relatively long time.

5. CONCLUSIONS

The spread of COVID-19 has caused severe and multifaceted consequences. To prevent it, mask wearing is one the most effective and important measure. However, the use of masks, itself, is not enough. More importantly, the correct use should be implemented [13]. This study found the complete prevalence of using masks for bus passengers in Hanoi, Vietnam. This result is attained because using masks is mandatory for utilizing bus. Nevertheless, up to 11% of passengers failed to wear masks correctly. To improve this situation, factors associated with the (in)correct use of masks were explored. Based on findings on such factors, this study proposes some policy implications, as follows. The role of ticket conductors in asking passengers to use

masks correctly should be enhanced. Passengers who is old, take heavy luggage, travelling with other(s) are more likely to omit to wear masks correctly; therefore, conductors should pay more attention to them and give polite and prompt instructions to those using masks incorrectly. If instructions are not respected, the refusal of providing bus services should be performed. The lack of attention to and adherence to the correct use of masks due to the long period witnessing no community transmission would be risky because no one can know when the coronavirus re-occurs. Hence, the frequent warnings and reminds of the authorities are essential. Bus operators should ask their drivers and conductors to keep following the safety regulations and request passengers, too.

This study, of course, is not perfect. The main limitation is that the definition of incorrect use of masks would be inadequate to some extent. This paper only considers how a passenger wears a mask on his/her face, but not the type of masks used and how many times a mask has been employed as recommended by the authors of [15]. Despite these shortcomings, this study, to the best of our knowledge is the first research on factors associated with the incorrect mask use for public transport passengers in a city where masks wearing is mandatory. Therefore, the findings of this paper has extended the literature on how to respond the effects of COVID-19 on public transport in emerging countries. Ongoing studies may consider the role of a personal health issue related to breathing ability in bus riders' incorrect use of masks. If this variable is significant, what should possible solutions be?

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