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Passengers’ self-protective intentions while using ride-hailing services during the COVID-19 pandemic

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ABSTRACT

In the transport context, there has been limited research examining passengers’ health-protective behaviour while travelling during a health-related crisis such as COVID-19. This study develops a conceptual model aiming to explore determinants associated with passengers’ self-protective intentions using the context of ride-hailing services in Vietnam. Ride-hailing services are popular in countries where public transport is underdeveloped. The conceptual model is based on perceived risk and self-efficacy as the main predictor of self-protective intentions when using ride-hailing services. In addition, the proposed conceptual model explores the direct and indirect impact of subjective knowledge and the perceived effectiveness of preventive measures on self-protective intentions. The proposed conceptual model was tested on a large sample of ride-hailing users in Vietnam (n = 527). The structural equation modelling (SEM) analysis results indicate that self-efficacy has the highest total impact on self-protective behaviour, followed by subject knowledge and perceived effectiveness of preventive measures. Self-efficacy also plays a fully mediating role in the linkage between the perceived effectiveness of preventive measures implemented by ride-hailing organisations and the intention to engage in self-protective behaviour. The results of this study expand the current understanding of ride-hailing passengers’ health-protective behaviour and contribute to the transport and public health literature.

1. Introduction

The COVID-19 pandemic has affected the global community with substantial morbidity and mortality and significant socio-economic effects (Rod et al., 2020). As of 15 August 2022 there were more than 588,004,722 confirmed cases of COVID-19 globally, with more than 6,432,073 related deaths, reaching all countries worldwide (WHO, 2021). In Vietnam, the first documented case of COVID-19 was announced on January 23, 2020. The infection numbers increased rapidly to 509 confirmed cases with zero deaths by the end of July 2020 (WHO, Situation report – 193, July 2020). To limit the spread of the virus, many countries, including Vietnam, implemented expedient measures such as restrictions on mobility and travel, physical distancing, and self-isolation or quarantine (Kucharski et al., 2020, Wells et al., 2020).

Vietnam has a growing economy and is considered one of the fastest-growing economies in the Asia-Pacific region (The World Bank, 2020). Mobility and travel demand increase significantly in line with this growth. Unfortunately, the development of public transport infrastructure does not always grow at the same pace. Buses are currently the only formal public transport mode in Vietnam that is often used by individuals with a low-income (e.g., students, factory workers) (Pham

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et al., 2021, Nguyen-Phuoc et al., 2021b). As such, when ride-hailing taxi services (e.g., Grab, GoViet) were introduced, they quickly became more prevalent, experienced rapid growth, and played a central role in the transport system of Vietnam in recent years (Nguyen-Phuoc et al., 2020b, Nguyen-Phuoc et al., 2021c). Additionally, in jurisdictions such as Vietnam, ride-hailing services offer a paid transport alternative that can appeal highly to the community. Ride-hailing services are convenient as they eliminate the difficulty and unpredictability of finding a taxi. Ride-hailing services are also relatively more secure (i.e., passengers have access to the identity of the driver and the recommended route) and safer (i.e., reduce the need to use riskier transportation options such as motorcycles in Vietnam (Viegas, 2008, Nguyen-Phuoc et al., 2021a). It is expected that this industry could reach US$4 billion by 2025 and become one of Southeast Asia’s fastest-growing ride-hailing markets (Deshmukh, 2021).

The spread of COVID-19 has significantly reduced mobility during periods of lockdowns and severe travel restrictions (Gosling et al., 2020, Wielechowski et al., 2020, Nguyen-Phuoc et al., 2022b). Additionally, governments have promoted infection prevention measures such as good hand hygiene and face mask use in public areas or during transit (Atangana and Atangana, 2020, De Angelis et al., 2021). COVID-19 has also influenced the perception of risk in the population, which, together with official advice and guidelines, have increased self-protective behaviours against COVID-19 among different groups of the population (Cori et al., 2020, Bonell et al., 2020, Nguyen-Phuoc et al., 2022a). After months of travel restrictions since July 2020, many countries have been entering a new phase in controlling the virus while maintaining economic growth (Spurrell, 2020). Vietnam has been recognised as one of the few countries that achieved net economic positive growth during the pandemic thanks to the effective measures implemented by the Vietnamese government (Minh, 2020). Although Vietnam has needed to strengthen its COVID-19 efforts, the overall outcome of its pandemic management has been positive (Huaxia, 2020). One of the key lessons has been that implementing self-protective behaviours could have a positive outcome (Huynh, 2020). Therefore, research aimed at understanding the determinants of these behaviours is vital to protect health. Transport industries, including ride-hailing organisations, have recognised the need for a proactive approach against COVID-19 and have implemented some important initiatives to promote self-protective behaviours. For example, in Vietnam, Grab has restricted a maximum of two passengers and encouraged passengers to sit in the backseat to minimise contact with drivers (Grab, 2021). However, there is no research explaining the determinants of these behaviours to guide evidence-led programs to promote and sustain them. A better understanding of predictive factors of personal protective behavioural intention is timely. It can provide ride-hailing organisations with response measures to develop their business during the COVID-19 pandemic to attract customers while contributing to an effective COVID-19 response.

Several theories attempting to explain individuals’ health-protective behaviours have been proposed such as Health Belief Model (HBM), Protection Motivation Theory (PMT), Social Cognition Theory (SCT), and Theory of Reasoned Action (TRA). The common premise of these theories is that motivation towards protection results from perceived threat and desire to avoid the potential negative outcome. In this study, PMT is chosen as a theoretical foundation to investigate the influence of two cognitive mediating processes (i.e., threat appraisal and coping appraisal process) on self-protective behaviours (Floyd et al., 2020). In terms of the coping appraisal, perceived risk is traditionally a variable linked to engaging or not in health-related behaviours (Orosco-Pontalvo et al., 2019). As part of the coping appraisal process, the PMT includes self-efficacy or belief and conviction that one can successfully perform a given activity as a separate component. Also, theoretical developments have suggested that self-efficacy could be affected by self-perceptions of knowledge (subjective knowledge) (Dodd et al., 2005). On the other hand, response efficacy, which considers the perceived effectiveness of taking preventive measures, is also a key variable associated with the coping appraisal process in the PMT. However, in the paid transport context, customers’ perception of the preventive measures of a transport service has not been examined. Arguably, the PMT is as comprehensive in its conceptual development as the other theories mentioned. A better understanding of the impacts of subjective knowledge, perceived effectiveness of preventive measures, and other PMT constructs (e.g., self-efficacy, perceived infection risk) on individuals’ intentions to engage in self-protective actions are needed.

The present study develops a conceptual model to analyse the intention to engage in self-protective behaviours in the ride-hailing context, considering passengers’ critical cognitive processes that have been found to influence behaviour in safety-critical contexts. Using data collected in July 2020 when vaccinations were not yet available in Vietnam, complex relationships among five constructs are investigated in this study, i.e., subjective knowledge, perceived effectiveness of preventive measures, self-efficacy, perceived infection risk, and intention to engage in self-protective behaviours. Interventions to promote health-protective behaviours among users of paid transport in low- and middle-income countries can be developed based on the findings of this study.

2. Theoretical foundation and hypotheses

2.1. Theoretical foundation

The Protection Motivation Theory (PMT) was initially applied to explain the mechanism in which individuals deal with threats (Rogers, 1983). According to PMT, the decision to engage in a health-protective behaviour is conceptualised as the combined effect of two perceptual processes: threat appraisal and coping appraisal. While threat appraisal examines the severity of a situation and assesses how serious a situation is, coping appraisal refers to how an individual responds to a situation. Threat appraisal encompasses the perceived severity of a threatening event, vulnerability, or susceptibility. Coping appraisal consists of self-efficacy (perceived individual ability to conduct the coping response successfully) and response efficacy (perceived effectiveness of proposed preventive measures). Individuals are likely to engage in protective behaviours when they believe that a lack of action poses a threat to themselves (high-threat appraisal) and that performing the preventative behaviours could mitigate that threat (high-coping appraisal). The mechanism of the two PMT pathways (threat and coping appraisal) has been widely studied to explain the engagement in preventative actions such as health-related behaviours (Milne et al., 2000); tourists’ travel behaviours in an infectious disease context (Wang et al., 2019); or pro-environmental behaviour in a natural disaster context (Janmaimool, 2017). Coping appraisal has been confirmed as a significant predictor of protective behaviour, whereas threat appraisal was often weakly associated with preventive actions in several previous studies (Fisher et al., 2018, Milne et al., 2000, Van der Velde and Van der Pligt, 1991). The relationships among these constructs are sometimes contradictory to Roger’s (1983) original assumptions (Wu et al., 2005, Greening and Stoppelbein, 2000). For instance, Greening and Stoppelbein (2000) found that young drivers’ perceived vulnerability to the risks of drinking and driving would be positively related to their intentions to drink and drive. Even though at-risk drivers recognised their vulnerability to the risks of drinking and driving, they perceived their risk to be average and not higher. It appears that the at-risk drivers minimised the magnitude of their personal vulnerability to the risks of drinking and driving.

In the present study, when theorising about the determinants of self-protective intentions to validate the PMT model in the ride-hailing service context, we conceptualised perceived risk as threat appraisal, and self-efficacy and response efficacy (perceived effectiveness of preventative measures implemented by ride-hailing firms) as the coping appraisal. The PMT also states that knowledge and experiences are critical determinants of perceived risk and self-efficacy. As the COVID-19 outbreak continues to evolve, the facts about the virus have often
changed, and transport systems had to adapt quickly to satisfy the needs of this new reality. Therefore, we have considered two constructs to account for the role of knowledge and experiences. Regarding knowledge, we have considered the extent an individual thinks they know about a topic (also known as subjective knowledge), which is usually an indication of consumer self-confidence (Park and Lessig, 1981). According to Flynn and Goldsmith (1999), subjective knowledge is directly related to many consumer behaviours since it is considered to be a consumer’s perception of the amount of information they have stored in their memory. In the health psychology literature, subjective knowledge, which is also known as self-perceived knowledge (Park et al., 1988), is an indicator of the judgment of one’s experience in a specific situation (e.g., public health crisis) (Jaccard et al., 2005). The link of environmental knowledge-attitude-behavioural intention, which was investigated in the context of eco-tourism (Powell and Ham, 2008), provided a foundation for the notion that subjective knowledge about a disease led to change in self-efficacy and self-protective behaviour.

As such, the present study hypothesised the influence of subjective knowledge and prevention measures from ride-hailing firms in forming self-efficacy (coping), perceived infection risk (threat), and passengers’ decision-making to protect themselves. Based on the PMT, as discussed above, we developed an integrated model of self-protective behaviour intentions during the COVID-19 pandemic. Fig. 1 presents the theoretical framework including five constructs: subjective knowledge, perceived effectiveness of preventive measures from ride-hailing firms, self-efficacy, perceived infection risk and intention to engage in self-protective behaviours.

2.2. Hypotheses development

The first construct is the intention to engage in self-protective behaviour, which is conceptualised in the present study as a passenger’s intent to take more care and engage in physical distancing and hand hygiene practices when using ride-hailing services. The intention is a predecessor of behaviour, whereby individuals form intent that they subsequently carry out as behaviours (Oviedo-Trespalacios et al., 2019). In this study, four constructs, including subjective knowledge, perceived effectiveness of preventive measures, perceived infection risk and self-efficacy, are hypothesised to have direct and indirect relationships with the intention to engage in self-protective behaviour.

The second construct is self-efficacy. In the context of the present study, self-efficacy relates to a passenger’s perception and beliefs that they can take preventive actions to avoid COVID-19. Self-efficacy has been previously defined as a person’s beliefs regarding performing specific behaviours (Bandura, 1977). Self-efficacy expectations indicate self-judgements of individual abilities and skills one possesses. Bandura’s study found three dimensions of self-efficacy expectations: magnitude, generality, and strength (Bandura, 1977). However, in this study, we focus on the strength dimension, which is considered to evaluate the degree of certainty about a person’s capability to engage in a behaviour (Bandura, 1977, de Vries et al., 1988). Bandura (1980) stated that “the relationship between knowledge and action is significantly mediated by self-referent thought” (p.263). In line with this notion, self-efficacy is considered one of the critical cognitive factors in determining behavioural intention, besides attitude and subjective norms (de Vries et al., 1988). Generally, a person with high self-efficacy is more likely to have high behavioural intentions (Bandura, 1977, Clowes and Masser, 2012, de Vries et al., 1988, Basen-Engquist and Parcel, 1992, Hagger et al., 2001). Previous research has found that self-efficacy was positively related to blood donation intentions in Australia (Clowes and Masser, 2012), sexual intentions and condom use (Basen-Engquist and Parcel, 1992), participation intentions in physical activities of young people (Hagger et al., 2001), and intentions of specific AIDS-preventive behaviours among adolescents in New York (Goh et al., 1996). As such, the present study proposed the following hypothesis:

H1: Self-efficacy is positively associated with the intention to engage in self-protective behaviour against COVID-19 while using ride-hailing services.

The third construct is perceived infection risk, which in the present study refers to an individual’s perceptions of the risk of being infected with COVID-19 whilst using a ride-hailing service. Perceived risk was initially introduced by Bauer (1960), which includes uncertainty – an individual’s probabilistic beliefs and consequences – importance loss. In the context of health behaviour, perceived risk could be understood as an individual’s perceptions about their vulnerability to several diseases and infections. Previous research has indicated that perceived risk has been considered a significant factor in predicting health-protective behaviours (Janz and Becker, 1984, Rimal, 2001). It is argued that people who are conscious of their susceptibility to various diseases will tend to take more self-protective behaviour (Yzer et al., 1998, Rimal, 2001). Therefore, this study assumes that individuals with a higher level of perceived infection risk possess stronger intentions to engage in self-
prolonged protective behaviours when using a ride-hailing service.

H2: Perceived infection risk is positively correlated with intention to engage in self-protective behaviour against COVID-19 while using ride-hailing services.

Subjective knowledge refers to an individual’s perception of how much they know about an issue, based on their experience, self-confidence or self-beliefs (House et al., 2004). In the context of COVID-19, subjective knowledge is how much an individual perceives that they know about the virus, its consequences and how to prevent infection (Pu et al., 2021). This construct is essential to study as it is more consistent than objective knowledge because the facts of the virus have evolved since its emergence and continue to do so. Compared with objective knowledge, subjective knowledge has been used extensively in previous behavioural studies (Brucks, 1985, Lin and Filieri, 2015).

The perceived knowledge level of individuals about COVID-19 might exert an important effect on their sense of protective efficacy. According to Prasetyo et al. (2020), an understanding of COVID-19 was found to have a significant indirect effect on perceived effectiveness of prevention measures among Filipinos in Luzon, Philippines. With misinformation and inaccurate COVID-19 related information, an individual could not be sure about the effectiveness of prevention measures (Laato et al., 2020). In the context of ride-hailing services, there has been a lack of research on the relationship between subjective knowledge and perceived effectiveness of preventive measures implemented by ride-hailing organisations. As such, this relationship was hypothesised and tested in this study. On the other hand, self-perceived knowledge was also considerably related to self-efficacy or a person’s particular set of beliefs that determine how well one can execute a plan of action in a prospective situation (Goh et al., 1996, Basen-Engquist and Parcel, 1992). Additionally, the Protection Motivation Theory (PMT) explains that knowledge influences health-related behaviour (Rogers, 1983). It is argued that people who perceive themselves to be more knowledgeable about an issue have higher self-efficacy than people with less knowledge (Lindberg, 2000). In a study of breast self-examination, Carpenter and Colwell (1995) asserted a positive and significant relationship between the illusion of knowing and self-efficacy for breast self-examination.

Other scholars such as Koklic (2011) and Klrick and Sweeney (2007) confirmed the positive influence of perceived knowledge on perceived risk. According to Bandura (1986), a higher level of knowledge would lead to successfully perform the specific behaviour. Indeed, the lack of knowledge could become a barrier to perform the skills (Trotta, 1980). Consistent with these findings, research on consumer behaviour has shown that there is a positive relationship between subjective knowledge and health behaviour in contexts such as breast self-examination (Sheley, 1983) and contraceptive use (Scott-Jones and Turner, 1988). It is assumed that individuals with more knowledge about a certain issue have a higher level of risk perception. In the context of the COVID-19 pandemic, the facts and knowledge of COVID-19 have changed very quickly and the amount of misinformation in the community is difficult to quantify. Therefore, the use of subjective knowledge is considered as a relevant construct to predict self-protective behaviours and influence self-efficacy, perceived effectiveness of prevention measures and perceived infection risk. Following these findings, we propose that:

H3: Subjective knowledge is positively associated with perceived effectiveness of preventive measures implemented by ride-hailing organisations.

H4: Subjective knowledge is positively associated with self-efficacy against COVID-19 while using ride-hailing services.

H5: Subjective knowledge is positively associated with perceived infection risk while using ride-hailing services.

H6: Subjective knowledge is positively associated with intention to engage in self-protective behaviour against COVID-19 while using ride-hailing services.

The COVID-19 pandemic has increased hygiene and safety awareness across many industries, including transport services (Shen et al., 2020, Hossain, 2021). If individuals perceived the COVID-19-related safety measures to be effective, they had more confidence in their capacity to respond to the COVID-19 pandemic successfully. Previous reports have shown that in a workplace context those who gave the lower effectiveness scores to their workplace protections were likely to be less confident about protecting themselves from the virus at work (de la Rosette et al., 2020). In the context of ride-hailing services, implementing safety and hygiene measures in vehicles could help reduce COVID-19 community transmission, which in turn contributes to protecting the health of drivers, passengers, and the broader community. As such, effective interventions implemented by ride-hailing organisations for improving safety awareness is expected to increase the level of confidence to avoid COVID-19 among ride-hailing passengers.

In mainland China and Hong Kong during COVID-19, healthcare workers were found to have a higher perceived level of risk in terms of fear and susceptibility of COVID-19 due to the adverse consequences of insufficient physical protection (e.g., personal protective equipment provision, training on infection control) (Lam et al., 2020). Since they did not feel sufficiently supported and protected in their work environments, they were likely to be depressed and leave their job (Chen et al., 2022). Additionally, there has been a study examining the adoption of health prevention measures among Vietnamese delivery riders during the pandemic (Tran et al., 2022). They found that the riders who received more support from their companies (e.g., provide sufficient hand sanitizer for riders, reminds riders to take preventive measures via their apps) were less likely to perceive the risk of contracting the virus. In the context of ride-hailing services, a passenger’s perception of the effectiveness of COVID-19 prevention measures implemented by ride-hailing organisations might influence the perception of infection risk, which in turn affect the intentions to engage in self-protective behaviours against COVID-19 while using ride-hailing services. For instance, if a passenger has a low level of the perceived effectiveness of preventive measures, they are likely to have higher infection risk perception and greater engagement in preventive behaviours. There has been a dearth of empirical studies undertaken to explore the effect of prevention measures implemented by ride-hailing organisations on ride-hailing passengers’ self-efficacy against COVID-19, their perceived risk, and self-protective behaviours. As such, the direct impacts of perceived effectiveness of ride-hailing organisations’ preventive measures are proposed as the following hypotheses:

H7: Perceived effectiveness of preventive measures implemented by ride-hailing organisations is positively associated with self-efficacy against COVID-19 while using ride-hailing services.

H8: Perceived effectiveness of preventive measures implemented by ride-hailing organisations is negatively associated with perceived infection risk while using ride-hailing services.

H9: Perceived effectiveness of preventive measures implemented by ride-hailing organisations is negatively associated with intention to engage in self-protective behaviour against COVID-19 while using ride-hailing services.

3. Research methodology

3.1. Measures

Measurement scales, which measured the constructs in the research model of this study, were developed based on the previous related studies (See Table 1). All scales were 7-point Likert response scales and ranged from 1 — “strongly disagree” to 7 — “strongly agree”. Subjective knowledge, which focused on respondents’ subjective knowledge about COVID-19, was measured by three items adapted from Régner et al. (2018) and one item developed by the authors. Self-efficacy, which focused on respondents’ confidence in dealing with COVID-19, was measured by five items drawn from Ruan et al. (2020). Perceived effectiveness of preventive measures from ride-hailing organisations, which focused on passengers’ perception of prevention measures implemented by ride-hailing organisations, was measured by two items
Minh City, Vietnam. A total of three items, in which two items were developed by the authors, were used to measure perceived infection risk. Finally, four items were derived from Dolnicar (2005) and one item was developed by the authors, were used to measure perceived infection risk. Finally, four items were derived from Dolnicar (2005) and one item was developed by the authors. A total of three items, in which two items were developed by the authors, were used to measure perceived infection risk. Finally, four items were derived from Dolnicar (2005) and one item was developed by the authors.

### Table 1
Measurement scales.

| Code | Subjective Knowledge (SKN) | Mean  | Standard Deviation | Kurtosis | Skewness |
|------|---------------------------|-------|--------------------|----------|----------|
| SKN1 | I think I have enough knowledge about COVID-19 | 5.137 | 1.283 | 0.581 | -0.845 |
| SKN2 | I think I know well the preventive measures against COVID-19 | 5.330 | 1.176 | 0.721 | -0.888 |
| SKN3 | I think I have a good knowledge of COVID-19 transmission routes | 5.357 | 1.222 | 0.692 | -0.839 |
| SKN4 | I know clearly about the COVID-19 situation in my country* | 5.340 | 1.307 | 0.531 | -0.887 |

Self-efficacy (SEF)

| Code | Self-efficacy (SEF) | Mean  | Standard Deviation | Kurtosis | Skewness |
|------|---------------------|-------|--------------------|----------|----------|
| SEF1 | I am confident in my ability to protect myself from COVID-19 | 5.186 | 1.175 | 0.864 | -0.935 |
| SEF2 | I am certain that I will take these actions even if they are difficult or inconvenient | 5.209 | 1.12 | 0.181 | -0.573 |
| SEF3 | I have the willpower to engage in these precautionary actions to protect myself from COVID-19 | 5.114 | 1.26 | 1.102 | -0.934 |
| SEF4 | I am confident that I can carry out these precautionary actions to protect myself from COVID-19 | 5.416 | 1.079 | 0.419 | -0.693 |
| SEF5 | I am certain that I can control myself to reduce the chances of getting COVID-19 | 5.493 | 1.008 | 0.632 | -0.728 |

Perceived Effectiveness of Preventive Measures (PPM)

| Code | Perceived Effectiveness of Preventive Measures (PPM) | Mean  | Standard Deviation | Kurtosis | Skewness |
|------|---------------------------------------------------|-------|--------------------|----------|----------|
| PPM1 | I think ride-hailing organisations have a suite of safety and hygiene measures to minimise risks of the spread of COVID-19 on their transport services (e.g., provide face masks and hand sanitisers to drivers and passengers, encourage partners to check their temperature daily and submit it on the ride-hailing driver app) | 5.188 | 1.121 | -0.057 | -0.570 |
| PPM2 | I think drivers deploy necessary precautionary measures to tackle the spread of COVID-19 (e.g., clean the cars frequently, wear masks, or limit themselves from talking with you) | 5.288 | 1.143 | 0.326 | -0.689 |

Perceived Risk (PIR)

| Code | Perceived Risk (PIR) | Mean  | Standard Deviation | Kurtosis | Skewness |
|------|----------------------|-------|--------------------|----------|----------|
| PIR1 | I might be exposed to the risk of COVID-19 when I use ride-hailing services | 4.964 | 1.402 | 0.131 | -0.698 |
| PIR2 | I might become infected with COVID-19 when I use ride-hailing services | 4.985 | 1.430 | 0.046 | -0.672 |
| PIR3 | I might become infected with COVID-19 if the cars have carried infected passengers* | 5.095 | 1.380 | 0.034 | -0.675 |

Intention to Engage in Self-protective Behaviour (IES)

| Code | Intention to Engage in Self-protective Behaviour (IES) | Mean  | Standard Deviation | Kurtosis | Skewness |
|------|-------------------------------------------------------|-------|--------------------|----------|----------|
| IES1 | I will be more careful than usual while travelling | 5.488 | 1.060 | 0.785 | -0.803 |
| IES2 | I will restrain myself from touching my eyes, nose, and mouth while travelling | 5.528 | 1.025 | 0.750 | -0.812 |
| IES3 | Due to COVID-19, I will limit contacts with drivers while travelling | 5.433 | 1.119 | 0.548 | -0.781 |
| IES4 | I will take prevention measures against COVID-19 (e.g., wearing masks, using hand sanitisers) while travelling | 5.552 | 1.058 | 0.187 | -0.657 |

Note: * indicates items developed by the authors.

### Table 2
Survey respondent characteristics.

| Characteristics     | n  | %  | Occupation          | n  | %  |
|---------------------|----|----|---------------------|----|----|
| Gender              |    |    |                     |    |    |
| Female              | 272| 51.6| Full-time employee  | 203| 38.5|
| Male                | 255| 48.4| Part-time employee  | 90 | 17.1|
| Age                 |    |    | Student             | 181| 34.3|
| Mean (Standard Deviation) | (12.03) |    | Retired             | 17 | 3.2|
| Level of education  |    |    | Other               | 36 | 6.8|
| High school         | 63 | 12.0| Monthly income (VND) |    |    |
| College             | 68 | 12.9| <5 million          | 200| 38.0|
| University          | 251| 47.6| 5-10 million        | 130| 24.7|
| Above university    | 145| 27.5| >15 million         | 126| 23.9|
| Frequency           |    |    |                     |    |    |
| >2 times/week       | 57 | 10.8|                     |    |    |
| 1-2 times/week      | 99 | 18.6|                     |    |    |
| >3 times/month      | 151| 28.7|                     |    |    |
| <1 time/month       | 221| 41.9|                     |    |    |

Note: 1 USD = 23,000 VND.

### 3.2. Data collection and participants

Data was collected using a self-administered paper-based questionnaire from July 12 to July 24, 2020. Ride-hailing service users in Ho Chi Minh City, Vietnam’s business and financial hub, were defined as the target population for the study, with no specific ride-hailing service targeted. Firstly, the well-trained survey teams randomly approached people at various sites, where there was a high demand for ride-hailing services (e.g., mall, hospital, supermarket). Then, a screening question was asked to establish whether the potential participants have travelled by ride-hailing services in the past year. If they said ‘Yes’ and agreed to participate in the study, the surveyors would introduce the participants to all relevant information about the survey, such as the purpose and objectives of the study and their rights to be part of this research.

Additionally, the surveyors highlighted that the survey was confidential and that their responses would be anonymous. Participants were asked to carry out the questionnaire in situ, and a small monetary incentive of US$1 was given if they completed the whole questionnaire. More than 600 questionnaires were distributed; however, only 562 completed the questionnaire. After removing invalid questionnaires (e.g., missing data, same values in most of the variables), 527 questionnaires of ride-hailing users were retained and used for further analysis.

The respondent characteristics are presented in Table 2. The average age of the participants was 33 years (SD = 12.03 years). Approximately 51.6 % of respondents were female, while 48.4 % were male. Regarding participants’ educational background, nearly half of respondents held a university degree, comprising the highest percentage of the total at 47.6 %. The second-largest group, who had a university post-graduate degree, accounted for 27.5 % of the total. 12.9 % and 12 % of participants reported holding college degrees and high school educational backgrounds, respectively. In terms of monthly income, approximately 38 %
earned <5 million VND per month, 24.7 % had a monthly income from 5 to 10 million, and 23.9 % and 13.5 % of respondents earned from 10 to 15 million VND and above 15 million VND, respectively. The primary employment type of respondents were full-time employees (38.5 %) and students (34.3 %), accounting for the highest figures of the total, followed by the group of part-time employees (17.1 %). The retired group only constituted 3.2 % of the total. Regarding the frequency of ride-hailing service use, approximately 41.9 % of respondents used ride-hailing services less than once per month. By contrast, respondents who engaged in ride-hailing services more than twice per week accounted for the fewest participants (10.8 %). The other two groups with the frequency of 1–3 times per month and 1–2 times per week, accounted for 28.7 % and 18.6 % of the total respondents, respectively.

3.3. Data analysis

The present study analysed the data using Structural Equation Modelling (SEM). Stemming from econometrics, SEM has been increasingly applied in different disciplines (e.g., psychology, education, sociology, marketing). SEM is defined as "a class of methodologies that seeks to represent hypotheses about the means, variances, and covariances of observed data in terms of a smaller number of structural parameters defined by a hypothesised underlying model" (Kaplan, 2008, p.1). A structural equation model includes two components: (1) the measurement model, which links the measurement items (observed variables) to the latent variables; and (2) the structural model, which links each latent variable to others using systems of simultaneous equations. SEM is often used for exploratory studies, especially those involving behavioural and psychological issues having complicated inter-relationships (e.g., direct and indirect) among latent variables. Recently, SEM has gained popularity in the analysis of the complex psychology of transport users (Allen et al., 2020, Rahman et al., 2016, Nguyen-Phuoc et al., 2021d, Su et al., 2019).

Partial least squares structural equation modelling (PLS-SEM) was used to validate the developed model since it had more advantages than covariance-based structural equation modelling (CB-SEM). Unlike CB-SEM, smaller sample sizes could be used for the PLS-SEM approach even though the models were complicated. Additionally, PLS-SEM did not require the restrictive distributional assumptions of the constructs used in the analysis as the PLS algorithm transforms nonnormal data per the central limit theorem (Cassell et al., 1999). Finally, PLS-SEM typically achieves greater statistical power levels and demonstrates much better convergence behaviour than the CB-SEM approach (Reinartz et al., 2009). SmartPLS 3 software was chosen for the data analyses in the present study. There were two main steps in the data analysis. Firstly, the reliability and validity of the measurement model were tested to ensure the properties of the measurement items. Secondly, the structural model was examined to test the hypotheses.

4. Results

4.1. Measurement model

The present study assessed the measurement model using confirmatory factor analysis (CFA) which confirmed and refined measurement items as the components of latent variables. Normally, a reflective measurement model is assessed based on three criteria, including internal consistency reliability, convergent validity, and discriminant validity (Hair et al., 2016). Reliability referred to the intercorrelations of measurement items while validity indicated how correctly a set of measurement items could represent a construct conceptualised in a study (Hair et al. 2016). Internal consistency reliability was measured using Fornell’s composite reliability (CR) and Cronbach’s Alpha (CA). The results indicated that CR and CA ranged from 0.821 to 0.927, which were well above the threshold value of 0.7, thus demonstrating the reliability of the measurement scales (Fornell and Larcker, 1981). In terms of assessing convergent validity, two indicators were used, including outer loadings and average variance extracted (AVE). The results from Table 3 show that most items (except for SEF3) had outer loadings exceeding the recommended level of 0.6 (for adapted measurement items) (Hair et al., 2010). The AVE values of five latent variables were also higher than the cut-off value of 0.5 (Fornell and Larcker, 1981), with the AVE for self-efficacy variable at least 0.539 as the lowest score. Hence, convergent validity, which refers to “the extent to which a measure correlates positively with alternative measures of the same construct” (Hair et al., 2016), was achieved.

According to Fornell and Larcker (1981), a latent variable has adequate discriminant validity if the square root of AVE for the variable was greater than the variance shared between the variable and other variables in the model. The results from Table 4 show that the correlations between each pair of variables were lower than the square root of AVE for the relevant variables, confirming discriminant validity. In addition to the traditional approach, Henseler et al. (2015) proposed a reliable alternative approach to assess discriminant validity which is the Heterotrait-monotrait ratio of correlations (HTMT). Table 5 indicated that all values of HTMT, with 0.796 being the highest, were significantly below the suggested threshold value of 0.85 (Henseler et al., 2015, p. 117, Clark and Watson, 1995). Results from both approaches confirmed the discriminant validity of the constructs. Hence, it can be concluded that all evaluation criteria for the reliability, convergent and discriminant validity were satisfied, so the measurement models were supported.

4.2. Structural model

Table 4

Fornell-Larcker Criterion of the first-order factor model.

| Construct | AVE | SKN | PPM | SEF | PIR | IES |
|-----------|-----|-----|-----|-----|-----|-----|
| SKN       | 0.726 | 0.852 |
| PPM       | 0.825 | 0.446 | 0.908 |
| SEF       | 0.539 | 0.482 | 0.479 | 0.734 |
| PIR       | 0.810 | 0.174 | 0.152 | 0.453 | 0.900 |
| IES       | 0.620 | 0.484 | 0.409 | 0.707 | 0.472 | 0.787 |
was used to examine the research hypotheses. The process of assessing the structural model included three major steps.

First, the fit of the developed model was examined via several goodness-of-fit indices of the structural model, namely standardised root mean square residual (SRMR) and the Normed Fit Index (NFI). The value of SRMR was 0.049, which was lower than the cut-off value of 0.08 (Henseler et al., 2016), and the NFI value was 0.890, exceeding the threshold value of 0.8 suggested by Hu and Bentler (1998). Additionally, the squared Euclidean distance (d-ULS), the geodesic distance (d-G), and Chi-square values were 0.364, 0.261 and 711.107, respectively. A well-fitting model is confirmed since these values meet the requirement of fit criteria.

Second, the predictive capability of the model was determined using predictive accuracy ($R^2$-value) of an endogenous construct, which was used to measure the predictive accuracy of a model, quantified the proportion of variance explained by its determinants (exogenous) linked to it and ranges between 0 and 1 (Tabachnick et al., 2007). The constructs in this proposed model explained 3.4 % of the variance in perceived infection risk (PIR), 19.8 % of the variance in perceived effectiveness of preventive measures (PPM), 31.6 % of the variance in self-efficacy (SEF) and 67.7 % of the variance in intention to engage in self-protective behaviour (IES). It could be said that IES was highly related to four constructs on IES. SEF is found to have the strongest total effect on IES ($\beta = 0.046$). The relationship between SKN and IES is the lowest ($\beta = 0.223$, $t = 4.724$, $p < 0.001$) which supports H1, H2, and H6.

Table 5 indicates the total effect (direct and indirect effect) of constructs on IES. SEF is found to have the strongest total effect on IES ($\beta = 0.677$, $t = 11.373$, $p < 0.001$), PIR ($\beta = 0.142$, $t = 3.811$, $p < 0.001$) and SKN ($\beta = 0.131$, $t = 2.926$, $p < 0.001$) which supports H1, H2, and H6.

There are five significant indirect path relationships in the proposed model. As can be seen from Table 6, the indirect effect of SKN and PPM on IES via SEF are significant and much higher than other indirect relationships. SEF plays a partial mediating role in the relationship between SKN and IES ($\beta = 0.227$, $t = 5.210$, $p < 0.001$) and PPM and IES ($\beta = 0.223$, $t = 4.724$, $p < 0.001$). The mediating impact of PIR on the relationship between SKN and IES is the lowest ($\beta = 0.019$, $t = 1.999$, $p = 0.046$).

Table 6 Results of indirect effects.

| Indirect path | Path Coefficient ($\beta$) | SD | $t$-value | $p$-value |
|---------------|-----------------------------|----|-----------|-----------|
| SKN $\rightarrow$ PPM $\rightarrow$ SEF $\rightarrow$ IES | 0.100*** | 0.023 | 4.347 | < 0.001 |
| SKN $\rightarrow$ SEF $\rightarrow$ IES | 0.227*** | 0.044 | 5.210 | < 0.001 |
| SKN $\rightarrow$ PIR $\rightarrow$ IES | 0.019** | 0.009 | 1.999 | 0.046 |
| SKN $\rightarrow$ PPM $\rightarrow$ SEF | 0.147*** | 0.028 | 5.189 | < 0.001 |
| PPM $\rightarrow$ SEF $\rightarrow$ IES | 0.233*** | 0.047 | 4.724 | < 0.001 |

Notes: SD = standard deviation, ns = non-significant, *** $p < 0.01$, ** $p < 0.05$.
explaining that individuals safety among paid transport passengers in Vietnam (and potentially risk, and intention to engage in self-protective behaviours. Transport empirically examine the intention to engage in self-protective behaviours. Exploring the relationships among subjective knowledge, perceived infections while using ride-hailing services. Ultimately, this will have gers to engage in self-protective behaviours to reduce COVID-19 in gers to engage in self-protective behaviours to reduce COVID-19 in hailing users’ intentions to engage in self-protective behaviour. The current investigation results are helpful to increase the safety of ride- hailing services. Specifically, the findings support stakeholders in designing effective behaviour change programs that encourage passengers to engage in self-protective behaviours to reduce COVID-19 in fections while using ride-hailing services. Ultimately, this will have significant benefits for communities and industry as fewer infections mean a more successful economic recovery.

In terms of theoretical implications, the present study is the first to empirically examine the intention to engage in self-protective beha
vours among ride-hailing passengers during the COVID-19 pandemic. The context of the study is a low- and middle-income country where ride-hailing services are considered an informal form of public transport. Consequently, the study findings significantly contribute to the emerging literature on ride-hailing and other paid transport services by exploring the relationships among subjective knowledge, perceived effectiveness of preventive measures, self-efficacy, perceived infection risk, and intention to engage in self-protective behaviours. Transport and health stakeholders could develop interventions to increase COVID-19 safety among paid transport passengers in Vietnam (and potentially other low- and middle-income countries) given that the relationships identified show pathways to influence intentions to engage in health- protective behaviours.

The present study develops a theoretically driven framework to explore ride-hailing passengers’ intentions. The findings support the main assumptions of the Protection Motivation Theory (PMT), explaining that individuals’ intentions to engage in self-protective actions are significantly influenced by both threat (e.g., perceived infection risk) and coping appraisal (e.g., self-efficacy, response efficacy) (Wang et al., 2019, Floyd et al., 2000). Therefore, behaviour change initiatives in the context of the COVID-19 pandemic and public transport should consider both elements to develop effective infection-prevention programs. In terms of the total effect, self-efficacy had the highest impact on the intentions to engage in self-protective behaviours compared to other variables. This is in line with previous research indicating that self-efficacy had the most substantial effect on the intentions and behaviours (Floyd et al., 2000, Milne et al., 2000). Self-efficacy is a key component across most health behaviour theories (Schwarzer, 1999), and the present study further confirms this finding in the COVID-19 context.

Another critical variable that influenced passengers’ intentions of COVID-19-related self-protective behaviour was perceived risk. This is consistent with previous research showing that people concerned with COVID-19 infections also have stronger intentions to engage in health-protective behaviours (Bults et al., 2011, Faasse and Newby, 2020).

**Table 7**

| Total effects | Path Coefficient | SD | t-value | p-value |
|---------------|------------------|----|---------|---------|
| SEF → IES     | 0.677***         | 0.060 | 11.373 | <0.001 |
| SKN → IES     | 0.484***         | 0.042 | 11.613 | <0.001 |
| PPM → IES     | 0.241***         | 0.056 | 4.348  | <0.001 |
| PIR → IES     | 0.142***         | 0.037 | 3.811  | <0.001 |

Notes: SD = standard deviation, * = non-significant, *** p < 0.01, ** p < 0.05.

The COVID-19 pandemic has resulted in significant health risks for paid transport passengers. The present study developed a framework explaining the potential contribution of psychological constructs on ride-hailing passengers’ intentions to engage in self-protective behaviour. The current study was the first to examine the indirect relationships between subjective knowledge, perceived effectiveness of preventive measures and self-protective behaviours (Bults et al., 2011, Faasse and Newby, 2020).

This is in line with previous research that has shown that people with a high level of knowledge regarding COVID-19, its mode of transmission, and preventive measures are likely to engage in self-protective behaviours. As such, the Protection Motivation Theory (PMT) appears to be a sound theory to study safety-related behaviour during public health crises such as the COVID-19 pandemic.

Subjective knowledge also appears to directly influence passengers’ intentions to engage in self-protective COVID-19-related behaviours. This is not surprising since the role of perceived risk has been well-established as a determinant of self-protective behaviours in the transport environment (Oviedo-Trespalacios et al., 2020, Orozco-Fontalvo et al., 2019, King et al., 2021, Nguyen-Phuoc et al., 2020a, Oviedo-Trespalacios et al., 2021). However, several studies have shown that risk perceptions do not influence the decision-making process. For instance, Fisher et al. (2018) only confirm the role of coping appraisal (e.g., response-efficacy, self-efficacy) in determining cruise passengers’ intentions to wash their hands as a form of self-protective behaviour. Perceived severity and perceived susceptibility do not affect passengers’ protective intentions. This might be due to the differences in passengers’ subjective knowledge about a disease that directly affects the perception of risk (Dodd et al., 2005). As the consequences of COVID-19 are more serious that a common infection previously encountered on cruises (i.e., common flu), it is reasonable to hypothesise that perceptions of risk in our study have a more predominant role in the intentions engaging in self-protective Motivations. As such, the Protection Motivation Theory (PMT) appears to be a sound theory to study safety-related behaviour during public health crises such as the COVID-19 pandemic.

Perceptions about the safety and health initiatives initiated by ride-hailing organisations were found to indirectly influence the intentions to engage in COVID-19-related self-protective behaviour via the self-efficacy of passengers. It means that higher perceived effectiveness of preventive measures from ride-hailing organisations, such as the availability of face masks and hand sanitisers, makes passengers feel more confident in their ability to protect themselves from COVID-19. Additionally, this creates a sense of urgency to engage in such behaviours via perceived risk. This confirms that industry-led initiatives have a role in the success of COVID-19 suppression programs. Since the COVID-19 pandemic, Grab has rolled out two new in-app features, including an online health and hygiene declaration form and a mask selfie tool. Grab’s drivers submit daily health declarations through the Grab Driver App and take a selfie using the mask selfie tool after completing the declaration (Grab, 2020). Uber has also implemented a “no mask, no ride” policy, requiring all drivers and riders to wear masks and follow other health guidelines during rides (The Ehrhardt Group, 2020).

This current study was the first to examine the indirect relationships between perceived effectiveness of preventive measures and self-protective behavioural intention via self-efficacy. Future research is needed to replicate and further delineate the underlying mechanisms.

The present study offers several practical implications for ride-hailing organisations and for authorities to help passengers make their trips safer during the global pandemic. Our findings provide a clear understanding of how passengers are motivated to engage in risk protective behaviours and determine which are the influential primary constructs. For example, the results indicate that self-efficacy is the most critical construct of ride-hailing passengers’ self-protective behaviours.
during the COVID-19 pandemic. This is key considering that most of the messaging about COVID-19 has sought to communicate the risks but not to increase self-efficacy, which is a missed opportunity to improve safety. As such, more attention should be directed to increasing passengers’ self-efficacy whilst communicating the risks and facts about COVID-19. This is consistent with guidelines from the World Health Organisation (WHO) which encourages policymakers to consider regulating/providing information regarding pandemic management in the transport context, including hand hygiene, disinfecting practices, physical distancing, and promotion of active travel options to reduce contact/exposure (WHO, 2020). Finally, ride-hailing organisations are suggested to implement and promote safety and hygiene measures to reduce risks of the spread of COVID-19 on their transport services as this will improve the behaviour of passengers. For instance, they should provide safety recommendations on their booking apps, update safety policies to align with health advice, and offer transport hygiene supplies. Such practices can help ride-hailing organisations to increase community compliance with health advice.

6. Limitations and future research

The present study has some limitations that provide scope for future research. First, the data used in this study was only collected from ride-hailing passengers in Vietnam. Hence, the perception of ride-hailing passengers in other countries where COVID-19 management has been different might not be comparable. Further research should be conducted in other countries to generalise the results as cultural disposition towards ride-hailing or even the COVID-19 pandemic might influence ride-hailing passengers’ behaviour. Second, the potential moderating effects of demographic characteristics (e.g., age, gender, and education level) on the developed model did not yield any insights into differences potentially attributable to demographic factors. However, some other passenger characteristics not explored in the present study could be significant. Hence, there is a need to understand the difference in behavioural intention among different groups of passengers. Third, the present study includes only a limited number of constructs to preserve parsimony and provide a practical framework that ride-hailing organisations can quickly implement. Future research should develop the framework further to investigate the impacts of additional factors such as contextual factors (e.g., social media, government policies), which might influence perceived health-related risk. Additionally, essential confounders may be missing from this study. Issues such as scepticism and misinformation about the COVID-19 pandemic and its health consequences may influence passengers’ intentions to engage in self-protective behaviours. Future research should consider these variables when studying the safety behaviour of public transport passengers in the COVID-19 pandemic. Finally, the findings of this study can be further expanded by exploring the intention to use other public transport modes during the COVID-19 pandemic.

7. Conclusion

The present study examines how passengers’ intentions to engage in self-protective COVID-19-related behaviours are formed in the context of ride-hailing services. An integrated model was developed to test the inter-relationships among five constructs, including subjective knowledge, perceived effectiveness of preventive measures, self-efficacy, perceived infection risk, and intention to engage in self-protective behaviour. The findings show that self-efficacy has the most substantial impact on self-protective behaviours among ride-hailing passengers. However, the remaining three factors also have significant effects on the behavioural intention, with lower total effects. The findings are helpful for ride-hailing organisations and authorities to protect their passengers and reduce the spread of COVID-19 in the transport system.

CRediT authorship contribution statement

Duy Quy Nguyen-Phuoc: Conceptualization, Data curation, Methodology, Writing – original draft, Writing – review & editing. Deep Ngoc Su: Data curation, Methodology, Writing – original draft. My Thanh Tran Dinh: Writing – original draft. James David Albert Newton: Writing – original draft, Writing – review & editing. Oscar Oviedo-Trespalacios: Writing – review & editing, Writing – original draft, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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